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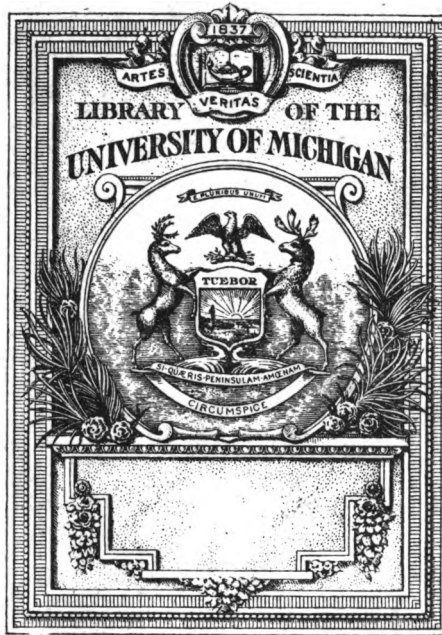
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**BIENNIAL REPORT OF THE DIRECTOR
1914-1916**

AND

**REPORT ON RETRACEMENT AND PERMANENT
MONUMENTING OF THE MICHIGAN-
OHIO BOUNDARY**



THE GIFT OF
Mich. Geological Surv.

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MICHIGAN GEOLOGICAL AND BIOLOGICAL SURVEY.

Publication 22.

Geological Series 18.

BIENNIAL REPORT OF THE DIRECTOR

AND

**REPORT ON RETRACEMENT AND PERMANENT
MONUMENTING OF THE MICHIGAN-
OHIO BOUNDARY.**



**PUBLISHED AS A PART OF THE ANNUAL REPORT OF THE BOARD OF
GEOLOGICAL AND BIOLOGICAL SURVEY FOR 1916.**



**LANSING, MICHIGAN
WYNKOOP HALLENBECK CRAWFORD CO., STATE PRINTERS
1916**



BOARD OF GEOLOGICAL AND BIOLOGICAL SURVEY, 1916.

EX OFFICIO:

THE GOVERNOR OF THE STATE,
HON. WOODBRIDGE N. FERRIS.

THE SUPERINTENDENT OF PUBLIC INSTRUCTION,
HON. FRED L. KEELER.

THE PRESIDENT OF THE STATE BOARD OF EDUCATION,
HON. THOMAS W. NADAL.

DIRECTOR,
R. C. ALLEN.

SCIENTIFIC ADVISORS.

Geologists.—Dr. L. L. Hubbard, Houghton; Prof. W. H. Hobbs,
Ann Arbor; Prof. W. H. Sherzer, Ypsilanti.

Botanists.—Prof. E. A. Bessey, East Lansing; Prof. F. C. Newcombe,
Ann Arbor.

Zoologists.—Prof. W. B. Barrows, East Lansing; Prof. J. Reighard,
Ann Arbor; Dr. Bryant Walker, Detroit.

Michigan Geological Survey 4-23-179

LETTER OF TRANSMITTAL.

*To the Honorable, the Board of Geological and Biological Survey of
the State of Michigan:*

Gov. Woodbridge N. Ferris.

Hon. Fred L. Keeler.

Hon. Thomas W. Nadal.

Gentlemen:—I have the honor to transmit herewith an administrative report for the biennium ending June 30th, 1916, with the recommendation that it be printed and bound as Publication 22, Geological Series 18.

Very respectfully,

R. C. ALLEN,

Director.

Lansing, Michigan,
July 30, 1916.

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ORGANIZATION OF THE GEOLOGICAL AND BIOLOGICAL SURVEY.

The Board of Geological Survey was created in 1869 for the purpose of making a thorough *geological* and *mineralogical* survey of the state. In 1905 the Board was authorized and directed to make "a thorough *biological* survey of the state" and to engage with the federal government in a co-operative topographic survey of Michigan. In 1911 the duties which prior had devolved on a Commissioner of Mineral Statistics were transferred to the Board of Geological Survey, and in 1913 co-operative relations were established with the Board of State Tax Commissioners for the appraisal of mines and mineral lands for taxation.

The present organization of the Survey embraces three departments, viz.:

(1) The Geological Survey, including three separate divisions, which are

- (a) Division of Geology,
- (b) Division of Appraisals,
- (c) Division of Mineral Statistics.

(2) The Topographic Survey.

(3) The Biological Survey.

EXPENDITURES.

The act of 1869 provides a fund of \$8,000.00 per annum for the Board of Geological Survey, but since 1905 this has been augmented by additional funds, through biennial appropriations by the legislature, necessary for progress with the topographic and biologic surveys and for the discharge of co-operative work with the Board of State Tax Commissioners. The total of appropriations for all purposes, for the fiscal year ending June 30, 1913, was \$20,500.00, and for the fiscal year ending June 30, 1914, \$36,300.00. I submit below classified accounts of expenditures for the biennium showing (1) the actual cost of the various activities and investigations and (2) a classified list of expenditures, as shown on vouchers paid by the State Treasurer

from the continuing or general appropriation and by the Treasurer of the Board of Geological Survey from the special appropriations. I present also the names of the persons employed by the Board of Geological Survey during the biennium, the capacities and length of time in which such persons were employed and total salary received.

EXPENDITURES OF THE BOARD OF GEOLOGICAL SURVEY.
1914-1915 and 1915-1916. (Fiscal years ending June 30th.)

Work.	Total.	Salary.	Subsistence.	Travel.	Assistance.	Property.	Office.	
							Permanent	Incidental.
Topographic survey, 1914-1915 and 1915-1916.....	\$13,960 86	\$6,585 89	\$4,642 09	\$2,555 24	.....	.....	\$85 47	\$112 17
Appraisal of mines, 1914-1915 and 1915-1916.....	11,192 62	9,678 56	497 33	402 79	.....	.....	317 71	296 23
General and miscellaneous office and correspondence work, etc., 1914-1915 and 1915-1916.....	9,268 50	8,332 78	25 68	78 78	.....	.....	370 26	333 14
Michigan-Ohio Boundary line re-survey, 1915-1916.....	4,006 31	2,282 53	622 24	416 88	\$17 00	\$120 86	.....	44 18
Biological Survey, 1914-1915 and 1915-1916.....	2,805 87	2,696 38	1 75	16 34	12 25	635 98	.....	79 15
Geological Survey of west end of the Marquette range, 1915-1916.....	2,458 44	1,606 86	263 30	332 43	48 40	40 80	4 00	162 65
Geological Survey of east end of Gogebic range, 1914-1915.....	2,156 14	1,520 83	282 95	160 89	36 10	13 00	15 50	144 87
Mineral statistics, 1914-1915 and 1915-1916.....	2,028 20	1,742 19	3 65	9 00	5 16	.....	.....	254 98
Study of limestones, 1914-1915 and 1915-1916.....	1,610 48	1,220 17	66 60	66 50	104 70	3 10	3 53	145 88
Geological survey of Silver Mountain, 1915-1916.....	923 12	576 25	172 06	148 78	.....	.....	.....	26 03
Geological study of the Devonian formations, 1914-1915 and 1915-1916.....	636 66	539 00	.....	.....	.....	.....	.....	97 66
Geological study of the Marshall and Coldwater formations, 1915-1916.....	431 19	183 25	168 00	38 24	.....	.....	.....	41 70
Physiography of Michigan inland lakes, 1914-1915 and 1915-1916.....	390 51	189 68	.....	165 55	.....	.....	.....	35 28
Geological survey of Mackinac Island, 1915-1916.....	251 95	150 00	29 97	56 83	.....	.....	.....	15 15
Cage reading on Escanaba river, 1914-1915 and 1915-1916.....	72 90	72 90	.....	.....	.....	.....	.....	.....
Total.....	\$52,211 75	\$37,327 27	\$6,775 62	\$4,448 25	\$248 11	\$813 74	\$809 69	\$1,789 07
July 1, 1916:								
Unexpended balance, general appropriation.....	167 71							
Unexpended balance, special appropriation.....	847 40							
Unexpended balance, Michigan-Ohio appropriation.....	4 22							
Unexpended balance, topographic survey appropriation.....	4,979 53							
Total.....	\$58,210 61							

BIENNIAL REPORT OF THE DIRECTOR.

13

430, 434, 402, 408, 492, 507, 519, 522, 526, 531, 537, 562, 568, 568, 566.	Bibbee, E. C.	Topographic Aid.	933 22	461 94	398 94	73 03	114 57	1 68
50, 57.	Bludeau, Geo. G.	Bookbinder.	114 57					5 75
22.	Bottner, L.	Map agent.	1 68					
28, 133.	Bovee, F. N.	Photographer.	5 75					
68.	Brennan, P.	Provision house.	83 01					
2, 8, 13, 21, 27.	Brown, Floyd B.	Compassman.	128 62	94 67	8 30	25 65		
531, 551.	Bunge, Wm. H.	Rodman.	65 17	30 67	34 50			
362.	Turney, Alfred E.	Topographic Aid.	46 69	24 19	22 50			
327, 332, 359, 357, 362, 363, 368.	Turney, H. E.	Junior Topographer.	307 45	170 20	115 20	22 05		
429, 459, 490, 505, 528, 550.	Burrell, F. E.	Rodman.	424 84	181 59	243 25			
3, 6.	Campbell, C. Alfred	Chairman.	191 50	100 00	91 50			
42, 109.	Carlson Supply Co.	Supply house.	32 58				29 70	2 88
438, 515, 568.	Chamberlin, Geo. L.	Liverman.	166 50				8 00	16 25
47, 96, 86, 90.	Chicago Press University.	Publishers.	24 25				10 00	
6, 189.	Chilton, McKinley & Co.	Publishers.	10 00					
7, 10, 6, 41, 90, 143, 70, 105, 145.	Christie, Wm. J.	Rodman.	85 00	40 00	45 00			87 45
21, 65, 106, 75.	Citizens Telephone Co.	Telephone Co.	87 45					23 87
60, 127.	Cleaver, Geo. C.	Carriage Co.	23 87					16 82
142.	Com. Env. & Box Co.	Supply house.	16 82					2 70
	Commercial Service Co.	Supply house.	2 70					
460, 491, 506, 529, 552.	Coy, Richard S.	Rodman.	350 42	162 92	187 50		1 65	
100.	Crowell Co., Thos. T.	Publishers.	1 65					
432, 461, 466, 487, 513, 538.	Culbert, C. M.	Liverman.	290 75			290 75		
327, 357, 362, 368.	Davis, C. M.	Rodman.	162 52	110 02	52 50		13 00	
119.	Demaray, D. E.	Binder.	13 00					
20.	Detroit Coin Wrapper Co.	Supply house.	1 50					1 50
106.	Diamond Drill.	Publishers.	8 00					8 00
4, 8.	Diets, C. A.	Liverman.	262 50			262 50		
27, 47, 51, 58, 59, 77, 91, 129, 147, 181, 187, 19, 74, 136, 60, 76.	Dietsgen Co., Eugene.	Supply house.	163 04			8 12	28 60	126 32
11, 25, 88.	Dodge, C. K.	Botanist.	400 00	400 00				
61, 74, 103, 113, 128, 145, 80, 73, 85, 122, 146.	Dudley Paper Co.	Supply house.	77 00					77 00
124.	Dunbar, Francis J.	Blind manufacturer.	16 61				16 61	
76.	Dyer, Jenson Barry Co.	Bonding Co.	5 00					5 00
132.	Economic Geology.	Publishers.	3 00				3 00	
75, 81, 4, 10, 14, 17, 26, 28, 61.	Ehlers, Geo. M.	Paleontologist.	365 49	158 25	168 00	38 24		

CLASSIFIED LIST OF EXPENDITURES OF THE BOARD OF GEOLOGICAL SURVEY FOR THE FISCAL YEARS 1914-1915 AND 1915-1916.—Continued.

Number of voucher.	Name.	Classification.	Total.	Salary.	Subsist- ance.	Travel.	Assist- ance.	Property.	Office.	
									Perma- nent.	Inciden- tal.
147.....	Elbe File & Binder Co.	Supply house.	\$6 26						\$6 26	
123, 138.....	Eng. & Mining Journal.	Publishers.	12 00						12 00	
520, 539.....	Poland, Christopher.	Rodman.	42 50	\$20 00	\$22 50					
3, 6, 9, 11, 13, 15.....	Furst Livery Co.	Liveryman.	97 00			\$27 00				
	Gannett, Samuel S.	Geographer.	1,588 54	1,225 00	216 00	59 85		\$57 69		
94.....	General Land Office.	Supplies.	6 00					6 00		
53.....	Golden Rule Sup. House.	Supply house.	5 00						5 00	
72, 38.....	Grabau, A. W.	Paleontologist.	450 00	450 00						
65.....	Graham, Jane.	Copyist.	3 75				\$3 75			
514.....	Grauger, C. B.	Liveryman.	70 00			70 00				
29, 18, 32, 75.....	Gurley, W. & L. E.	Instrument dealers.	28 31							
71, 84.....	Hagle, Maud.	Copyist.	8 50				8 50	15 00		\$13 31
461, 489, 496, 508, 530, 535, 551.....	Hain, E. L.	Assistant topographer.	834 23	576 00	226 63	31 61				
430, 462, 492, 507, 525, 531, 562, 563.....	Hall, M. F.	Topographic aid.	569 59	259 84	309 75					
1, 17, 28, 36, 53, 54, 55, 56, 57, 58, 60, 61, 62, 63, 66, 68, 12, 20, 30, 37, 42, 45, 46, 48, 49, 51, 52, 64, 72.....	Hamilton, O. R.	Mining engineer.	5,421 58	4,800 00	390 81	240 77				
87, 90.....	Hankinson, T. L.	Biologist.	200 00	200 00						
402.....	Harris, George.	Rodman.	51 69	21 94	29 75					
469, 523.....	Hawes, E. K.	Liveryman.	16 50			16 50				
43.....	Heikinen and Cayanus.	Provision house.	13 28		13 28					
328, 334.....	Hicks, Wm. R.	Rodman.	51 61	51 61						
465.....	Hinkley Brothers.	Liveryman.	47 50			47 50				
165.....	Hobbs, W. H.	Member Bd. of Advisers.	2 58							
	Hodges, Guy.	Rodman.	42 50	20 00	22 50					
56, 72, 87, 122, 176, 26, 67, 116, 63, 79.....	Hopper, W. E.	Geologist.	525 06	500 00	3 25	11 65	10 16	6 00		
	Hotchkiss, W. O.	Geologist.	6 00							

7 40, 76	Hubbard, Bela	Geologist	99 43	11 25	88 18			
68 81	Hyde, Joe	Compassman	29 88	26 67	2 71			
594	Hyman, Charles	Liveryman	6 00		6 00			
7, 67, 115, 131, 151, 167, 186, 129,	Iling Bros. Everard Co.	Supply house	36 95					36 95
144	Innes, Lewis	Photographer	9 00					9 00
86	Iron River-Stambaugh Rep.	Publishers	1 50					1 50
78, 91	Iron Trade Review	Publishers	8 00					
3, 6	Jackson, R. B.	Rodman	153 50	73 50		8 00		
402	Johnson, A. B.	Rodman	60 81	25 81	35 00			
429, 433, 459, 484, 509, 512, 532,	Jones, Oscar	Topographic engineer	877 38	283 98	174 75			
553, 569, 573	Jones, S. G.	Rodman	431 05		418 65			
429, 459, 490, 505, 528, 550	Kavanagh, A. J.	Junior topographer	84 06	50 81				
402	Kelly Brothers	Supply store	29 70	29 70				
43	Kendrick, Geo. F.	Rodman	31 94	31 94				
328	Kenton Store Co.	Provision house	194 47	194 47				
5, 22, 23	Krise, Wm. Earl	Rodman	412 68	176 43	236 25			
429, 459, 490, 505, 528, 550	Kurta, Langhein & Swartz	Supply house	3 33			3 33		
46	Lamb, W. E.	Liveryman	141 50		141 50			
361, 365, 366, 370	Laan, Louis	Rodman	42 50	20 00	22 50			
460, 491, 506, 529, 552	Laughlin, Howard S.	Rodman	360 08	168 08	192 00			
327, 329, 353, 357, 362, 367, 369,	Lee, L. L.	Assistant topographer	1, 355 04	757 98	252 13			
389, 390, 391, 400	Linton, L. L.	Recorder	241 50	150 00	91 50			
3, 6	Lloyd Brothers	Monument Mfgs	450 00		450 00			
7	Longstreet Lbr. Co.	Lumber dealers	3 60			3 60		
107	McDonald, R.	Exploration manager	68 51	68 51				
21	McGraw-Hill Book Co.	Publishers	33 85			33 85		
11, 32, 46, 44	McKone, Don T.	Rodman	432 11	346 67	19 70			
16, 18, 42, 44, 46, 78, 2, 11, 13, 21,	Michigan Drug Co.	Supply house	127 46					
34, 64, 74	Mich. Engineering Society	Publishers	15 00			91 64	35 82	15 00
6, 26, 34, 178, 188, 15, 16, 29, 35,	Mich. Press Clipping Bu au.	News bureau	4 00			4 00		
49, 53, 80	Mich. State Tel. Co.	Telephone Co.	73 21					73 21
89	Michigan, University of	Educational institution	104 70			104 70		
8, 33, 43, 93, 143, 192, 193, 21, 34,	Mining Journal	Publishers	4 00					4 00
108	Mining World	Publishers	6 00					6 00
30, 110	Mourre Sales Co.	Supply house	250 00				250 00	
8, 149								
65								

CLASSIFIED LIST OF EXPENDITURES OF THE BOARD OF GEOLOGICAL SURVEY FOR THE FISCAL YEARS 1914-1915 AND 1915-1916.—Continued.

Number of voucher.	Name.	Classification.	Total.	Salary.	Subsist- ance.	Travel.	Assist- ance.	Property.	Office.	
									Perma- nent.	Inciden- tal.
501.....	Muck, E. G.	Provision house.	\$51 29		\$51 29					
460, 470, 491, 506, 517, 529, 534, 554.....	Muldrow, Robert.	Topographic engineer.	1,074 17	\$766 17	211 75	\$98 70				
334, 336.....	Murphy, J. J.	Rodman.	20 64	20 64						
184, 126.....	Nelson, Alfred.	Rodman.	42 50	20 00	22 50					
13.....	Newcombe, F. C.	Member Bd. of Advisers.	5 21			5 21				
27.....	Novy, Frank.	Naturalist.	82 00	82 00						
327, 333, 360, 357, 364, 368, 23.....	Null, H. H. Harrison.	Rodman.	42 50	20 00	22 50					
160.....	Nystrom & Co., A. J.	Supply house.	58 80						\$58 80	
10.....	Opdyke, Alfred L.	Topographic aid.	238 40	125 00	110 00	1 40			3 50	
52.....	Penton Publishing Co.	Publishers.	3 50							
191, 143, 155.....	Phillips, R. H.	Rodman.	85 00	40 00	45 00				8 00	\$4 41
10.....	Polk & Co., R. L.	Publishers.	8 00							
10.....	Postal Telegraph Co.	Telegraph Co.	4 41							
62.....	Povah, H. W. Alvah.	Botanist.	182 00	182 00						
64, 78.....	Presquele Mining Co.	Exploration Co.	44 25		44 25					
536, 557.....	Proudit Loce Leaf Co.	Supply house.	13 75						13 75	
164.....	Raymond, B. C.	Liveryman.	37 50			37 50				
142, 159, 177, 79, 14.....	Reighard, J.	Member Bd. of Advisers.	2 58			2 58				75 00
70.....	Reuter, Carl H.	Agent.	75 00							
5.....	Richardson, G. R.	Rodman.	42 50	20 00	22 50					
4, 2, 15, 24, 37, 55, 71, 86, 111, 121, 140, 157, 175, 13, 25, 41, 53, 66, 83, 101, 115, 134, 56, 64.....	Richmond, Marian.	Office assistant.	6 00				\$6 00			
70.....	Richmond, Mrs. K. V.	Stenographer.	1,780 00	1,780 00						
331, 337.....	Rogers Leather Gds. Store.	Supply house.	8 50						8 50	
9, 24, 163, 3, 19, 150.....	Russell and Masken.	Liverymen.	106 00			106 00				
	Ruthven, A. G.	Chief naturalist.	805 66	800 00	50	5 16				

328, 330, 335, 334, 400.	Sadler, C. L.	Topographic engineer.	594 03	414 83	182 32	16 88	6 00		
4.	Sawyer, Mrs. M. M.	Office assistant.	6 00						
	Schmitt, Wm., Jr.	Rodman.	42 50	20 00	22 50				
367, 399.	Schmitt, Wm., Jr.	Rodman.	123 88	57 68	66 00				
2, 13, 221, 31, 66.	Schwab, Joe.	Cook.	270 00	270 00					
2, 3, 29, 32, 33, 34, 66, 73.	Scott, I. D.	Geologist.	433 85	230 68	2 85	185 07			6 25
3	Senseny, H. S.	Topographer.	63 75	37 50	26 25				
17.	Sherman, C. E.	Inspector.	200 00	200 00					
3, 6.	Sherman, R. B.	Rodman.	134 50	70 00	64 50				
108.	Sherer, W. H.	Member Bd. of Advisers.	3 40		35	3 05			
555.	Silver, Glen C.	Liveryman.	108 00			108 00			9 00
42	Smith Bros., L. C.	Typewriter Mfgs.	9 00						
1, 2, 4, 17, 20, 28, 36, 52, 68, 83, 107, 118, 137, 164, 171, 69, 82, 11, 23, 39, 51, 64, 79, 98, 112, 131, 66, 64.	Smith, R. A.	Geologist.	3, 553 88	3, 384 66	72 20	90 40			3 62
3, 6.	Sorensen, F. G.	Chairman.	112 33	58 33	54 00	380 00			
463, 510, 511, 533, 556.	Sowersby, J. C.	Liveryman.	380 00						
77.	Sparks, M. F.	Tent manufacturer.	23 10			23 10			
504, 71.	Sponaler, O. L.	Biologist.	200 00	200 00					
39.	Stasak, J. G.	Topographic engineer.	105 37	79 12	26 25				
489, 503, 516, 530.	State treasurer.	Insurance fund.	53 48						53 48
	Stone, Harry H.	Rodman.	168 67	78 67	90 00				
92.	Supt. Public Documents.	Supplies.	3 70				3 70		
73.	Taylor, Frank B.	Geologist.	150 00	150 00					
18.	Terry Engraving Co.	Engravers.	105 99			105 99			
26, 35.	Thompson, Crystal	Naturalist.	200 00	200 00					
38, 66.	Tobin, James	Cook and compassman.	110 00	110 00					
99.	Toerring Co., C. J.	Supply house.	2 35						2 35
89.	Tomlinson, W. Harold	Slide manufacturer.	11 50			11 50			
89.	Traneau, E. N.	Biologist.	150 00	150 00					
19.	Turnbull, W. D.	Draftsman.	50 25	50 25					
9, 44, 134, 158, 69, 77.	U. S. B. P. Paper Co.	Supply house.	52 42				3 50		48 92
1, 17, 28, 36, 53, 54, 55, 57, 60, 62, 63, 66, 12, 20, 30, 37, 42, 45, 48, 51, 66, 64.	Vance, E. E.	Draftsman.	2,400 00	2,400 00					
161, 126.	Walker, Bryant	Member Bd. of Advisers.	7 00			7 00			
76.	Wagenvoord & Co.	Binders.	1 25				1 25		
118.	Washington Loose Leaf Co.	Supply house.	15 00				15 00		
43, 29.	Welborn, W.	Copyist.	17 45	17 45					

CLASSIFIED LIST OF EXPENDITURES OF THE BOARD OF GEOLOGICAL SURVEY FOR THE FISCAL YEARS 1914-1915 AND 1915-1916.—Concluded.

Number of voucher.	Name.	Classification.	Total.	Salary.	Subsid- ance.	Travel.	Assist- ance.	Property.	Office.	
									Perma- nent.	Inciden- tal.
460, 491	Wellington, C. F.	Rodman.	\$159 52	\$74 02	\$85 50					
9, 19, 30, 48, 81, 104, 166, 180, 18,	Western Union Co.	Telegraph Co.	66 66							\$66 66
33, 48, 57, 71, 94, 124, 144, 151.	Whitmore, Morris T.	Rodman.	122 77	56 77	66 00					
461										
3, 1, 3, 13, 14, 23, 36, 38, 53, 62,										
69, 79, 84, 88, 109, 112, 119, 123,										
138, 141, 155, 173, 174, 192, 74,										
12, 20, 24, 31, 40, 45, 52, 55, 65,										
80, 81, 96, 100, 103, 113, 140, 56,										
64, 67										
402	Wight, Harry R.	Secretary	3,107 70	2,400 00					\$47 64	660 06
	Wilson, J. H.	Assistant topographer.	115 97	70 97	45 00					
564, 567	Winn, Edward.	Liveryman	24 00			\$24 00				
403	Wolverine Auto Co.	Transportation Co.	63 00			63 00				
17	Wood, Frank E.	Supply agent.	4 00							4 00
12, 27	Wood, N. A.	Naturalist.	200 00	200 00						
8, 35, 75, 101, 146, 168, 54, 87, 135	Wyntp Hallen's C'r'd Co.	State printers.	115 56						28 50	87 06
429, 431, 459, 490, 505, 528, 550.	Yoakum, B. H.	Topographic aid.	499 34	235 22	252 00	12 12				
Total.			\$52,211 75	\$37,327 27	\$6,775 62	\$4,448 25	\$248 11	\$313 74	\$509 69	\$1,799 07
Unexpended balance July 1, 1916.			5,998 86							
Total.			\$58,210 61							

EMPLOYEES OF THE BOARD OF GEOLOGICAL SURVEY FOR THE FISCAL YEARS JULY 1, 1914 TO JUNE 30, 1915 AND JULY 1, 1915 TO JUNE 30, 1916.

Name.	Position.	Amount of salary received.	Period of time employed.	How employed.				
				Mineral statistics.	Geology.	Appraisal of mines.	Topography.	Biology.
Allen, H. J.	Rodman.	\$172 56	4 months, 10 days.					
Allen, R. C.	Director, State Geologist, Appraiser of Mines.	6,957 90	2 years.				*	*
Alverson, Miles C.	Rodman.	170 00	2 months.		*	*	*	*
Andrews, A. W.	Naturalist.	75 00	Contract.					
Barrett, L. P.	Assistant Geologist.	2,210 00	2 years.		*	*		
Bateson, Geo. R.	Rodman.	101 94	2½ months.				*	
Beauchamp, Regis	Gage Reader.	72 90	1 year, 1 month, 6 days.		*			
Bemis, E. L.	Topographic Aid.	29 03	20 days.				*	
Bibbee, E. C.	Topographic Aid.	461 94	6 months.		*		*	
Brown, Floyd B.	Compassman.	94 67	2 months, 11 days.					
Bunge, Wm. H.	Rodman.	30 67	23 days.				*	
Burney, Alfred E.	Topographic Aid.	24 19	15 days.				*	
Burney, H. E.	Junior Topographer.	170 20	2 months, 22 days.				*	
Burrell, F. E.	Rodman.	181 59	4½ months.				*	
Campbell, C. Alfred.	Chainman.	100 00	2 months.				*	*
Christie, Wm. J.	Rodman.	40 00	2 months.				*	
Coy, Richard S.	Rodman.	162 92	4 months, 3 days.				*	
Davis, C. M.	Rodman.	110 02	2½ months.				*	
Dodge, C. K.	Botanist.	400 00	Contract.					*
Ehlers, Geo. M.	Paleontologist.	159 25	2 months, 22 days.	*				
Folland, Christopher.	Rodman.	20 00	½ month.				*	
Gannett, Samuel S.	Geographer.	1,225 00	3½ months.					*
Graham, A. W.	Paleontologist.	450 00	Contract.		*			*
Graham, Jane.	Copyist.	3 75	16 hours.					*
Hagie, Maud.	Copyist.	8 50	16 hours and contract.					*

EMPLOYEES OF THE BOARD OF GEOLOGICAL SURVEY FOR THE FISCAL YEARS JULY 1, 1914 TO JUNE 30, 1915 AND JULY 1, 1915 TO JUNE 30, 1916.—*Concluded.*

Name.	Position.	Amount of salary received.	Period of time employed.	How employed.					
				Mineral statistics.	Geology.	Appraisal of mines.	Topography.	Biology.	Michigan-Ohio boundary.
Hain, E. L.	Assistant Topographer.	\$576 00	2 months, 8 days.						
Hall, M. F.	Topographic Aid.	259 84	6 months.						
Hamilton, O. R.	Mining Engineer.	4,800 00	2 years.		*	*	*	*	*
Hankinson, T. L.	Biologist.	200 00	Contract.						
Harris, George.	Rodman.	21 94	17 days.						
Hicks, Wm. R.	Rodman.	51 61	1 month, 9 days.						
Hodges, Guy.	Rodman.	20 00	1 month.						
Hopper, W. E.	Geologist.	500 00	2 years.	*	*		*	*	
Hyde, Jos.	Compassman.	26 67	1 month.						
Jackson, R. B.	Rodman.	80 00	1 month, 18 days.						*
Johnson, A. B.	Rodman.	25 81	20 days.				*	*	
Jones, Oscar.	Topographic Engineer.	283 98	1 1/2 months.				*	*	
Jones, S. C.	Rodman.	184 30	4 months, 18 days.				*	*	
Kavanaugh, A. J.	Junior Topographer.	50 81	21 days.				*	*	
Kendrick, Geo. F.	Rodman.	31 94	22 days.				*	*	
Krise, Wm. Earl.	Rodman.	176 43	4 months, 12 days.				*	*	
Lau, Louis.	Rodman.	20 00	1 month.				*	*	
Laughlin, Howard S.	Rodman.	168 08	2 months, 8 days.				*	*	
Lee, L. L.	Assistant Topographer.	757 98	6 months.				*	*	*
Linton, L. L.	Recorder.	150 00	2 months.				*	*	
McKone, Don. T.	Rodman.	346 67	6 1/2 months.		*			*	
Muldrow, Robert.	Topographic Engineer.	766 17	4 months.					*	
Murphy, J. J.	Rodman.	20 64	16 days.				*	*	
Neelson, Alfred.	Rodman.	20 00	1 month.				*	*	
Novy, Frank.	Naturalist.	82 00	Contract.					*	

Null, H. Harrison.....	Rodman.....	20 00	1 month.....	.....	.....	.....	.....
Opdyke, Alfred L.....	Topographic Aid.....	125 00	2 1/2 months.....	.....	.....	.....	.....
Phillips, R. H.....	Rodman.....	40 00	1 month.....	.....	.....	.....	.....
Povah, H. W. Alvah.....	Botanist.....	182 00	Contract.....	.....	.....	.....	.....
Richardson, G. R.....	Rodman.....	20 00	1 month.....	.....	.....	.....	.....
Richmond, Marian.....	Office Assistant.....	6 00	6 days.....	.....	.....	.....	.....
Richmond, Mrs. K. V.....	Stenographer.....	1,780 00	2 years.....	.....	.....	.....	.....
Rutledge, A. G.....	Chief Naturalist.....	800 00	2 years.....	.....	.....	.....	.....
Sadler, C. L.....	Topographic Engineer.....	414 83	2 months, 9 days.....	.....	.....	.....	.....
Sawyer, Mrs. M. M.....	Office Assistant.....	6 00	6 days.....	.....	.....	.....	.....
Saxon, William, Jr.....	Rodman.....	20 00	1 month.....	.....	.....	.....	.....
Shultz, William, Jr.....	Rodman.....	57 68	1 1/2 months.....	.....	.....	.....	.....
Schweitzer, Jos.....	Cook.....	270 00	4 1/2 months.....	.....	.....	.....	.....
Scott, I. D.....	Geologist.....	239 68	2 months, 3 days.....	.....	.....	.....	.....
Senseney, H. S.....	Topographer.....	37 50	1 month.....	.....	.....	.....	.....
Sherman, C. E.....	Inspector.....	200 00	Contract.....	.....	.....	.....	.....
Sherman, R. B.....	Rodman.....	70 00	1 month, 12 days.....	.....	.....	.....	.....
Smith, R. A.....	Geologist.....	3,384 66	2 years.....	.....	.....	.....	.....
Sorensen, F. G.....	Chairman.....	58 33	1 month, 5 days.....	.....	.....	.....	.....
Sponsler, O. L.....	Biologist.....	200 00	Contract.....	.....	.....	.....	.....
Staack, J. G.....	Topographic Engineer.....	79 12	1 month.....	.....	.....	.....	.....
Stone, Harry H.....	Rodman.....	78 67	2 months.....	.....	.....	.....	.....
Taylor, Frank B.....	Geologist.....	150 00	Contract.....	.....	.....	.....	.....
Thompson, Crystal.....	Naturalist.....	200 00	Contract.....	.....	.....	.....	.....
Tobin, James.....	Cook and Compassman.....	110 00	1 month, 11 days.....	.....	.....	.....	.....
Transeau, E. N.....	Biologist.....	150 00	Contract.....	.....	.....	.....	.....
Turnbull, W. D.....	Draftsman.....	50 25	8 days.....	.....	.....	.....	.....
Vance, E. E.....	Draftsman.....	2,400 00	2 years.....	.....	.....	.....	.....
Wallborn, W.....	Copist.....	17 45	6 1/2 days.....	.....	.....	.....	.....
Wellington, C. F.....	Rodman.....	74 02	1 month, 27 days.....	.....	.....	.....	.....
Whitmore, Morris T.....	Rodman.....	56 77	1 month, 13 days.....	.....	.....	.....	.....
Wight, Harry R.....	Secretary.....	2,400 00	2 years.....	.....	.....	.....	.....
Wilson, J. H.....	Assistant Topographer.....	70 97	23 days.....	.....	.....	.....	.....
Wood, N. A.....	Naturalist.....	200 00	Contract.....	.....	.....	.....	.....
Yakum, B. H.....	Topographic Aid.....	235 22	4 months, 21 days.....	.....	.....	.....	.....

PROGRESS OF THE GEOLOGICAL SURVEY.

Modern trends in the work of the state and federal geological surveys indicate a rapid awakening to opportunities for useful adaptations of their activities to administrative needs of the governments. Another significant trend is toward a closer adaptation of survey work to industrial progress, particularly in the development, use, and perpetuation of natural wealth in soils, rocks, and minerals, and in some states, including Michigan, game life.

These more direct services to the government and people are made possible, however, only through investigations of a strictly scientific character and it should not be overlooked by legislatures and governing boards that progress in purely scientific geology and biology is and will ever remain the basis of progress in economic directions. A survey which fails to make the most of its resources in both of these directions fails to discharge the obligations which opportunity and public need place upon it.

The Michigan Geological Survey co-operates with other departments of the government which have use for its services. Such co-operation now extends to the Board of State Tax Commissioners in appraising mineral lands and mines for taxation, to the Michigan Securities Commission in the administration of certain phases of the "blue sky" law, to the Public Domain Commission in certain matters affecting the state lands and waters, and to the Mackinac Island State Park Commission in certain work in progress on Mackinac Island. An account of this co-operative work during the biennium is given below:

COOPERATIVE WORK.

Cooperation with the Board of State Tax Commissioners. In 1913 the Board of Geological Survey entered into co-operation with the Board of State Tax Commissioners, at the request of the former, in making appraisals of mines and mineral lands for taxation. The results of this co-operation are fully accounted for in the current biennial report of the Board of State Tax Commissioners.

The appraisal of mines and mineral lands for taxation is an important responsibility and demands the best efforts and professional skill of the Survey. The permanent record of this work during the biennium

is embraced in two annual reports to the Board of State Tax Commissioners comprising several volumes of typewritten matter, plats, statistical tables, reports of the mining companies, and a number of communications on special subjects.

REPORTS OF THE STATE GEOLOGIST TO THE BOARD OF STATE TAX
COMMISSIONERS.

1914.

Volume 1. Contains formally executed general and financial statements of owners and operators of iron mines for the five years preceding January 1, 1914. 510 pages.

Volume 2. Contains complete record of appraisals of iron mines and iron ore bearing lands, and appraiser's descriptions and discussions of the properties. 484 pages.

Volume 3. Contains complete statistical tables for reference. 36 pages.

Volume 4. Contains statements of tonnage and value of ore in stock at the mines. 146 pages.

1915.

Volume 1. Contains formally executed general and financial statements of owners and operators of iron mines for the five years preceding January 1, 1915. 620 pages.

Volume 2. Contains complete record of appraisal of iron mines and iron ore bearing lands, and appraiser's descriptions and discussions of these properties. 560 pages.

Volume 3. Contains complete statistical tables for reference. 37 pages.

Volume 4. Contains complete statistical tables for iron mines, 1906-1915 inclusive. 128 pages.

Mr. O. R. Hamilton, Mining Engineer, has rendered efficient service throughout all of the work of mine appraisals.

Co-operation with the Public Domain Commission. The resources of the Survey and the services of some of its members have been utilized by the Public Domain Commission in various ways, more especially in comparative valuations of lands involved in exchange with private parties in furtherance of its policy of consolidating the state lands and forests. The State Geologist has also acted for the Commission in

investigation of trespass of sand and gravel dredgers in Lake Superior, Lake Michigan, and Lake St. Clair, and in consideration of royalty rates on sand and gravel dredged from waters wholly or partially under control of the state. On a number of occasions the State Geologist has attended meetings of the Commission, and has at all times endeavored to assist in those matters wherein his services are requested.

Co-operation with the Michigan Securities Commission. The general work of the Geological Survey and the services of some of its members are useful to the Michigan Securities Commission in the administration of the "blue sky law," particularly in considering applications of mining companies and, in some cases, land companies, for permission for sale of stocks and bonds in Michigan. Some of the matters on which advice is asked by the Commission from time to time demand very careful treatment involving investigations extending over a considerable time. In such cases the cost is borne by the applicant and paid to the individual charged with the work, who, under the regulations of the Board of Geological Survey, has the option of relief from duties without pay while engaged in such work or a corresponding reduction in vacation and sick leave.

During the biennium ending June 30, 1916, reports on the applications of the following companies were rendered to the Michigan Securities Commission:

Date.	Name and Address of Company.	Report by.
1914.		
Nov. 17	Regal Collieries, Ltd., Taber, Alberta, Canada.....	R. C. Allen.
Jan. 9	Lake Superior Land Co.....	R. C. Allen.
1915.		
June 16	White Pine Extension Copper Co.....	R. C. Allen.
July 31	Central Michigan Clay Products Co., Williamston, Michigan....	R. C. Allen.
Sept. 24	Cheboygan County Limestone Products Co., Mackinaw City, Michigan.....	R. A. Smith.
1916.		
Jan. 24	Minook Gold Dredging Co., Seattle, Wash.....	L. P. Barrett.
April 3	Assets Realizing Mines Corporation.....	R. C. Allen.
April 25	Jerome Victor Extension Copper Co. of Arizona.....	R. C. Allen.
April 27	Butte-Elk Park Extension Mining Co. of Montana.....	R. C. Allen.
May 5	Plattville Consolidated Lead & Zinc Mining Co., Beloit, Wisconsin.....	R. C. Allen.
May 9	Silica Brick Co., Detroit, Mich.....	R. A. Smith.
June 9	Breitung Hematite Mining Co., Ltd.....	R. C. Allen.
June 29	Fullers Earth Company of America.....	R. C. Allen.

Co-operation with the Mackinac Island State Park Commission. The following is quoted from my last biennial report: "Probably no other locality in Michigan holds more of historical interest than the Island of Mackinac. Its natural beauty combined with its location have made it the most popular of Michigan's summer recreation grounds. A considerable part of the island is under the administration of the

Mackinac Island State Park Commission, which is doing a commendable work of improvement and beautification and is maintaining and preserving the old buildings and military works of historical interest.

The geologic history of Mackinac Island is no less fascinating than its human history for there is recorded in the series of abandoned beaches, bars, spits, stacks, sea cliffs, and other shore features, a large part of the history of the ancestral Great Lakes. At the highest or Algonquin stage of the Great Lakes, Mackinac Island consisted of only a few acres of ground forming the highermost part now occupied by old Fort Holmes. As the waters of the ancient Great Lakes receded from their earlier shore lines and fell to lower and lower levels until the present stage was reached each successive lower stage was marked by its corresponding shore line features on the Island of Mackinac.

In the mapping and interpretation of these natural features of Mackinac Island the Geological Survey is not only doing an important educational work but is also furthering the plan of the Mackinac Island State Park Commission to add to the interest and enjoyment of the several hundred thousand people who annually visit the island. During the summer season of 1914 field investigations were completed, and it is planned during the winter to construct a map of the Island on a rather large scale on which the geologic and physiographic features will be delineated, this map to be accompanied by a brief descriptive text. It is also planned to call attention to the meaning and interpretation of the natural features of the island through a system of guide posts and signs to be erected by the Mackinac Island State Park Commission. The work on Mackinac Island is in charge of Mr. Frank B. Taylor to whose indefatigable labors we are indebted for much of our present knowledge of the history of the Great Lakes."

I regret to state that Mr. Taylor's health has been such that he has been unable to complete his monograph, but it is expected that publication will be made before the end of another year.

GEOLOGICAL WORK.

The geological work accomplished during the biennium includes, (1) preparation and completion of a general geologic map of Michigan, (2) completion of investigations and report on Michigan commercial limestones, (3) continuation of field and laboratory studies of the pre-Cambrian rocks of the Northern Peninsula and preparation of a report covering these investigations in 1910-14, (4) completion of studies and preparation of a report in two volumes on the Devonian

formations of Michigan, (5) continuation of studies of the Mississippian formations, (6) preparation of a report on the physiography of the inland lakes, (7) current work in connection with publication of the annual report on mineral resources and statistics of mineral production and (8) miscellaneous investigations connected with correspondence and conferences.

A Geological Map of Michigan. I am pleased to report that a geological map of Michigan has been compiled and is now in the hands of the engraver and printer. Surprising as the statement may seem, it must be said that no adequate geological map of this state has ever been published. Certain parts of the state, particularly the iron and copper districts and a few counties, have been studied in detail and correspondingly accurate geological maps of these areas have been published. But for many years there has been a great need for a general geological map of the whole state representing in considerable detail the distribution and order of succession of the rock formations. We have had the compilation of such a map under way for several years but publication has been postponed pending study of certain districts in which information has been meagre or unsatisfactory, particularly in the Northern Peninsula. There still remain certain areas in which the mapping is doubtful and others in which satisfactory differentiation between the formations of different ages is impossible. It is not deemed advisable, however, to longer delay the publication of a general map pending solution of doubtful questions of geology, some of which will require years of study. The map in its present form will be very useful; particularly in connection with an amply explanatory legend which accompanies it. This legend is an epitome of the geological history of the state and describes the different formations and their economic products in popular terms. The map will be especially valuable for instructional work in the schools and colleges of Michigan.

A Report on Michigan Limestone. Limestone is one of the important resources of Michigan. The production, particularly of the higher grades, is steadily increasing and will continue to increase as demanded in the expansion of the iron, chemical, paper and sugar industries. Michigan is peculiarly favored in the occurrence of extensive beds of high grade limestone on and near Lakes Huron and Michigan within reach by low cost transportation of the great limestone consuming industries of the Great Lakes region.

I am pleased to report that the investigation of the limestone resources of the state, which has been in progress since 1913 under charge of Mr. R. A. Smith, has been completed. Mr. Smith's report appears in Publication 21, Mineral Resources of Michigan. It was expected that

this report would be published in 1915 but it was found necessary to extend the investigations into 1916 to insure a thorough treatment of the entire subject. Mr. Smith has made a field examination of all of the districts and localities wherein limestone of commercial grade occurs, and has mapped the areas underlain, by commercial limestone in those regions to which development has not yet extended. The field investigations have been supplemented by thorough laboratory studies. In this work we have had the co-operation of all of the companies and individuals engaged in the Michigan limestone industry. Hundreds of drill records and thousands of limestone analyses have been supplied by the limestone operators. Without this co-operation the report would have been much less complete and valuable.

Studies of the pre-Cambrian Rocks of the Northern Peninsula. Field and laboratory studies of the pre-Cambrian rocks of the Northern Peninsula have been continued throughout the biennium. The main results of these investigations in 1910-14 have been summarized and published in Publication 18, Geological Series 15. During the summer of 1915 Mr. L. P. Barrett assisted by Messrs. Bela Hubbard, Don T. McKone, and Floyd B. Brown, were engaged in field mapping in the area between Gogebic Lake and the west end of the Marquette iron range. During the summer of 1916 these studies will be continued in the field by Mr. Barrett, in charge, assisted by O. R. Hamilton and Prof. I. D. Scott, geologists, and Messrs. Don T. McKone, James Tobin, and Joseph Hyde, compassmen. The area to be studied extends from the west end of the Marquette iron range westward and northward around the Huron Mountains, attention being mainly concentrated on the rocks of Huronian age and their relations to the overlying Keweenawan and underlying Archean terranes.

Studies of the Devonian Formations. During the biennium Dr. A. W. Grabau completed his studies on the Dundee, Traverse, and Antrim formations and has presented his report for publication. Dr. Grabau's work is an exhaustive treatment of the entire Devonian section and is abundantly illustrated, particularly the description of the faunal life of the Devonian seas. The work will be published in two volumes during the next biennium as the second of a series of monographs on the Paleozoic formations of the state.

Studies of the Mississippian Formations. Under a co-operative arrangement with the United States Geological Survey Dr. Geo. H. Girty, Paleontologist, has continued his studies of the Mississippian, comprising the formations known as the Coldwater shale and Marshall sandstone. Up to this time Dr. Girty's studies have been mainly

concentrated on the Marshall fauna and his report on this formation is almost completed. During the summer of 1915 Mr. George M. Ehlers was employed in field examinations of the Mississippian and the collection of fossils from its exposures under the supervision of Dr. Girty. It is probable that some additional collections will need to be made from the Coldwater formation.

Studies of the Paleozoic Formations of the Northern Peninsula. Our knowledge of the lower Paleozoic formations which form the Northern Peninsula east of a line from Marquette to Menominee is unsatisfactory. It is based on early observations of Houghton, Winchell, and Rominger supplemented by later somewhat cursory study by A. C. Lane and others. This area connects the much more studied and better known areas of correlative formations in Ontario and New York on the east and Wisconsin on the west and the solution of a number of important problems awaits a comprehensive investigation of the Michigan section. It would hardly be worth while to undertake a study of this large area except under a general plan providing for several years continuous field and laboratory studies by competent stratigraphers and paleontologists. Such a plan is under consideration. Pending the formulation of a definite program for this work Mr. Geo. M. Ehlers has been employed to make extensive fossil collections and general field study of the Niagaran formations during the summer of 1916 under the supervision of Prof. E. C. Case and R. A. Smith.

A Study of the Physiography of Michigan Inland Lakes. In my last biennial report a full account was made of the work of Dr. I. D. Scott on the physiography of Michigan inland lakes. Dr. Scott has had the preparation of a report on this subject under way during the biennium and should be able to finish it before the end of the present year.

The report will consist of two parts. Part 1 is intended to familiarize the lay reader with the manner of formation of lake basins, the forces which are active on the shores, the effects of these forces, and the processes through which lakes eventually become extinct. It includes a general statement of the topography of Michigan, a brief discussion of the work of running water and glaciers, a classification of lake basins and the manner of formation of the types found in this state, a statement of the work of waves, currents and ice and the resultant forms. Part 2 will contain descriptions of the shores of the various lakes treated individually. The physiographic forms and the manner of their formation will be discussed together with an account of the origin of the basin and the factors working towards the extinction of the lake.

Mineral Resources and Statistics. The annual report on statistics of production and progress of the mineral industries is one of the most generally useful and popular publications of the Survey. In this work we have the indispensable co-operation of the mineral producers as well as that of the United States Geological Survey. In addition to the statistical matter this report contains a directory of all of the mineral producers, statements of progress of the industries and each year a leading article on one of the mineral resources. The report for 1914 contains a very useful treatment of the copper deposits by Mr. R. E. Hore, the report for 1915 a valuable contribution on Michigan commercial limestones by Mr. R. A. Smith.

PROGRESS OF THE TOPOGRAPHIC SURVEY.

The topographic mapping of Michigan is part of a general plan which embraces all of the states and territories. The work is being executed by the United States government acting through the United States Geological Survey and in co-operation with many of the states. The plan of the survey in Michigan provides for the construction of a topographic map of the state in units or quadrangles of 15' of latitude by 15' of longitude. The area of a quadrangle is about 200 square miles. Each quadrangle map will be published on a scale of 1:62500 and will register with those of adjacent quadrangles making it easy to combine the separate sheets to form a map of a larger area such as a county, drainage system, or natural physiographic province. The vertical distance between contours will, however, not be the same for all quadrangles but will vary with the character of the topography. Flat lands, such as constitute the Saginaw basin, are mapped with a contour interval of five feet, hilly areas with twenty feet and other areas with ten feet.

It has been found by experience in many states that the best results in topographic mapping are obtained through co-operation with the federal government. The United States Geological Survey maintains a large organization of trained topographic engineers with ample equipment and experience necessary for the attainment of lowest possible cost consistent with a high standard of work. Furthermore the United States government desires to make a topographic survey of the whole country under a uniform plan applicable to all of the states and it is desirable that such topographic work as may be undertaken by the several states or by them in co-operation with the United States should conform to this general plan or should be of such character that it may be adapted to this plan without additional expense for field surveys.

The topographic survey of Michigan under the co-operative plan now in force began in 1903. Following are the expenditures by the state and federal governments including appropriations for the fiscal year 1916.

EXPENDITURES OF THE CO-OPERATIVE TOPOGRAPHIC SURVEY OF MICHIGAN.

Year.	By the State of Michigan.	By the United States Geological Survey.
1903.....	\$800 00	\$800 00
1905.....	2,000 00	2,000 00
1906.....	3,000 00	3,000 00
1907.....	3,000 00	3,000 00
1908.....	2,000 00	2,000 00
1909.....	2,000 00	2,000 00
1910.....	2,000 00	2,000 00
1911.....	2,000 00	2,000 00
1912.....	2,000 00	2,000 00
1913.....	2,500 00	2,500 00
1914.....	2,500 00	2,500 00
1915.....	15,000 00	15,000 00
1916.....	15,000 00	15,000 00

On June 30, 1916 there had been mapped in Michigan 7554 square miles or 13 per cent of the area of the state. The accompanying map shows the areas which have been completed and those in which work is in progress. In addition, many miles of transit and level lines have been run through areas to which topographic mapping has not extended.

Importance of the Topographic Survey to the Development of the State. The permanent bench or elevation marks, established by the topographic survey and the surveyors' notes are useful to county and state road engineers, particularly as all of these are on sea level datum. The use of a common datum in drainage, road, and other engineering will make possible direct correlation of level work throughout the state. In so far as possible the topographic survey adjusts its level lines to the needs of the State Highway Commissioner wherever a direct saving can be made by so doing.

The topographic survey of the whole country is one of the most important of the preparedness measures which are now occupying the attention of Congress and the nation. Only an insignificant fraction of the national border is topographically mapped and less than 40% of the country as a whole. A topographic map is essential to strategic distribution of troops and offensive and defensive maneuvers of infantry, artillery and cavalry. In regions where topographic maps are unavailable the needs of the military are not met with such hurried sketch maps as the army engineers are able to construct often in immediate advance of moving troops. The topographic survey today is not only

responsible for the construction of an accurate topographic map, but also for a minute inspection of the country from a military viewpoint under the guidance of the army engineers. A great deal of information of important military value is obtained each year by the topographers for the permanent records of the War Department.

The cost of topographic mapping of the United States is insignificant considering its importance from a military standpoint alone. It has been calculated that a zone twenty miles wide paralleling the entire national border could be made for the cost of a small cruiser. The topographic map of the state of Michigan can be completed for the cost to the state of mobilizing and supporting the Michigan National Guard at war strength for two months.

The topographic survey is an important aid to agricultural development because it renders possible the correlation, field study and mapping of soils with respect to topography and drainage. It is particularly valuable to development of artificial drainage because a good topographic map not only shows the areas which have natural and artificial drainage and those which need drainage but is also an adequate basis for drainage plans and saves the cost of preliminary drainage surveys. A topographic map is almost indispensable in prorating costs of drain work to beneficiaries and between two or more local governmental units as townships and counties.

Topographic maps are an indispensable aid to all kinds of hydrographic studies, local and general. They are needed by villages and cities for location and development of water supplies and in various forms of sanitary engineering. They are indispensable for a general investigation of stream flow, stream gaging, flood control, water powers, artesian flow, and general water supplies.

In road building and road improvements topographic maps are essential. They eliminate the cost of many preliminary surveys. They are especially useful in choosing routes for new roads and trunk lines for development and improvement.

There are many other important uses for topographic maps among which may be mentioned:

For improving rivers and smaller waterways.

In making investigations for the improvement of the plant and animal industries, and in a comprehensive study of physical and biological conditions in connection with the stocking of interior water with good fish and the locating of fish culture stations.

In locating and mapping the boundaries of life and crop zones, and in mapping the geographic distribution of plants and animals.

In plotting the distribution and spread of injurious insects and germs.

As a base map for the plotting of information relative to the geology and mineral resources.

In connection with questions relating to state, county and town boundaries.

As a means of promoting an exact knowledge of the country and serving teachers and pupils in geographic studies.

As base maps for the graphic representation of all facts relating to population, industries, and products or other statistical information.

In connection with legislation involving the granting of charters, rights, etc., when a physical knowledge of the country may be desirable or necessary.

PROGRESS OF THE BIOLOGICAL SURVEY.

A. G. RUTHVEN, Chief Naturalist.

The biological work of the Survey has made satisfactory progress during the last two years. As stated in the last biennial report (pgs. 83-7), a five year plan was recommended by the Board of Advisors to begin in 1915, and this plan has been followed with slight modifications. The field work may be listed as follows:

1914.

Investigation of the reptile-amphibian fauna of the Manistee Region, by Crystal Thompson.

A biological survey of the Whitefish Point Region, by N. A. Wood (birds and mammals), A. W. Andrews (beetles and flies), C. K. Dodge (flowering plants), A. H. Povah (lower plants).

1915.

Investigations toward a monograph on Michigan Algae, by E. N. Transeau.

Investigations toward a monograph on Michigan Fish, by T. L. Hankinson.

Investigations on the distribution of the phanerogamic plants of Michigan, by C. K. Dodge.

Excepting the work of Prof. Kaufman on the Agaracacae of Michigan, the manuscript of which has been submitted for publication in two volumes, none of the larger investigations were completed during the two years, and but one report was published by this division—a volume of miscellaneous papers on the zoology of Michigan. Manuscript reports upon the progress of the various pieces of work are in the hands of the Chief Naturalist, and a number of short papers have been published elsewhere with his permission. The papers based entirely or in part upon Survey material which have appeared during 1914 and 1915 are as follows:

Gaige, Frederick M. The Birds of Dickinson County, Michigan. 16th Rept. Mich. Acad. Sci., 74-91.

Gaige, Frederick M. The Formicidae of the Shiras Expedition to Whitefish Point, Michigan, in 1914. Occ. Papers Mus. of Zool., Univ. of Mich., No. 25, 1-4.

Wood, Norman A. Results of the Shiras Expeditions to Whitefish

Point, Michigan. Mammals. 16th Rept. Mich. Acad. Sci., 92-97; Birds, 55-73.

Thompson, Crystal. The Reptiles and Amphibians of Manistee County, Michigan. Occ. Pap. Mus. of Zool., Univ. of Mich., No. 18, 1-6.

Thompson, Crystal and Ruthven, A. G. On the Occurrence of *Clemmys insculpta* (LeConte) in Michigan. Ibid., No. 12, 1-2.

Cockerell, T. D. A. Bees from the Northern Peninsula of Michigan. Ibid., No. 23, 1-10.

Hankinson, T. L. Young Whitefish in Lake Superior. Science, Vol. XL, No. 1024, 239-240.

Miscellaneous Papers on the Zoology of Michigan. Michigan Geological and Biological Survey, Publication 20, Biological Series 4.

Andrews, A. W. The Beetles of Charity Island, Michigan.

Hankinson, T. L. The Fish of Whitefish Point, Michigan.

Hankinson, T. L. The Fish of Houghton County, Michigan.

Colbert, Roy J. An Ecological Study of the Fish Fauna of the Douglas Lake Region, with Special Reference to the Mortality of the Species.

Evans, Arthur T. Dragonflies of the Douglas Lake Region, Michigan.

Thompson, Crystal. The Reptiles and Amphibians of Monroe County, Michigan.

PLANS FOR 1916.

As stated, the five year plan becomes effective on July 1, 1915. This plan provides for the following investigations in 1916:

Continuation of the survey of Michigan wood-lots.

Investigations of the phanerogamic flora of the State.

Investigations toward a monograph of the fishes of Michigan.

The wood-lot survey will be under the direction of O. L. Sponsler, the study of the distribution of the higher plants of the state will be made by C. K. Dodge, and the work on the fishes will be done by T. L. Hankinson.

The Chief Naturalist desires to call attention to the loyal support which is being given to the Survey by the naturalists who are making the investigations for this division. Every man has included in his estimates of the cost of proposed investigations only field expenses. It is the interest and cooperation of these men, which have not seldom been attended by real sacrifices, that makes it possible to obtain the maximum results upon the available appropriations.

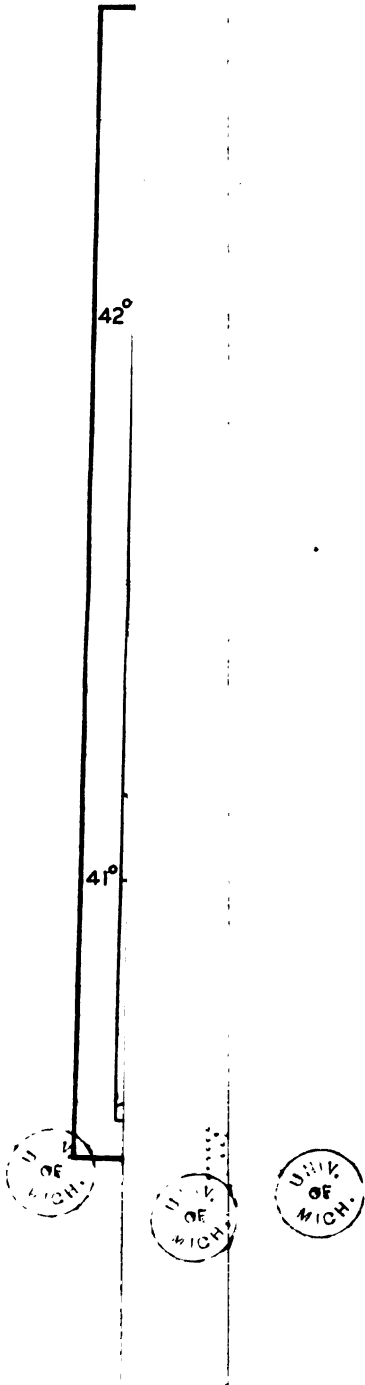
RETRACEMENT AND PERMANENT MONUMENTING

OF THE

MICHIGAN - OHIO BOUNDARY

S. S. GANNETT,
Engineer.

R. C. ALLEN,
C. E. SHERMAN,
Commissioners.



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LETTER OF TRANSMITTAL.

July 1, 1916.

To Their Excellencies:

Hon. Frank B. Willis, Governor of Ohio.

Hon. Woodbridge N. Ferris, Governor of Michigan.

Hon. Board of Geological Survey of Michigan.

Sirs:—The undersigned beg to submit the following report on the relocation and permanent monumenting of the Ohio-Michigan boundary, and recommend the adoption of the following report with the joint resolution therein contained, by the legislatures of both states.

Very respectfully,

C. E. SHERMAN, Inspector,
Ohio Topographic Survey.

R. C. ALLEN, Director,
Michigan Geological Survey.

LIST OF ILLUSTRATIONS.

- Plate I. Map showing disputed area and actual relative positions of Lakes Erie and Michigan.
- Plate II. Governor Ferris, of Michigan, and Governor Willis, of Ohio, shaking hands over terminal monument, November 24th, 1915.
- Plate III. Map showing location of posts 1 to 7 inclusive.
- Plate IV. Map showing location of posts 7 to 15 inclusive.
- Plate V. Map showing location of posts 15 to 22 inclusive.
- Plate VI. Map showing location of posts 22 to 30 inclusive.
- Plate VII. Map showing location of posts 30 to 38 inclusive.
- Plate VIII. Map showing location of posts 38 to 46 inclusive.
- Plate IX. Map showing location of posts 46 to 54 inclusive.
- Plate X. Map showing location of posts 54 to 63 inclusive.
- Plate XI. Map showing location of posts 63 to 71 inclusive.
- Plate XII. Specification for intermediate posts.
- Plate XIII. Specification for western terminal monument.
- Plate XIV. Photographic illustration of intermediate posts.
- Plate XV. Photograph of portion of Mitchell's map of 1755.
- Plate XVI. Photograph of portion of Hutchins' map of 1778.

PART I.

REPORT OF COMMISSIONERS.

REPORT OF COMMISSIONERS.

Authority for executing the work of the commissioners is contained in the following legislation:

Forty-eighth Legislature of Michigan.

Act 84, Public Acts of 1915.

To provide appropriations for the State Board of Geological Survey for the fiscal years ending June 30, 1916, and June 30, 1917, and to provide a tax to meet the same

The People of the State of Michigan enact:

Section 1. There is hereby appropriated to the State Board of Geological Survey for the fiscal year ending June 30, 1916, the sum of twenty-eight thousand six hundred dollars for purposes and by amounts as follows: * * * *

For relocation, establishment and imperishable monumenting of the boundary between Michigan and Ohio, three thousand six hundred dollars: Provided, That the state of Ohio shall jointly with Michigan bear an equal share of the cost thereof, otherwise no portion of the appropriation herewith made shall be expended for said joint boundary survey * * * *

Sec. 3. The several sums appropriated by the provisions of this act shall be paid out of the general fund in the state treasury at such times and in such amounts as the general accounting laws of the state prescribe, and the disbursing officer shall render his account to the auditor general thereunder.

Sec. 4. The auditor general shall incorporate in the state tax for the year 1915, the sum of twenty-eight thousand six hundred dollars, and for the year 1916, the sum of twenty-five thousand dollars, which amounts, when collected, shall be credited to the general fund to reimburse the same for the moneys hereby appropriated.

Passed April 20, 1915.

Approved April 27, 1915.

WOODBIDGE N. FERRIS,
Governor.

Eighty-first General Assembly of Ohio.

House Bill No. 701.

Be it Enacted by the General Assembly of the State of Ohio:

Section 1. The sums set forth in sections 2 and 3 of this act in the columns therein designated "Appropriations" for the purpose therein specified, are hereby appropriated out of any moneys in the state treasury not otherwise appropriated. * * * *

Sec. 2. The following sums shall not be expended to pay liabilities or deficiencies existing prior to July 1, 1915, or incurred subsequent to June 30, 1917. * * * *

TOPOGRAPHIC SURVEY.

F Contract and Open Order Service—

F 9. General Plant—

To be paid upon vouchers approved by the governor who is hereby authorized to arrange for carrying on such work, including surveying and monumenting jointly Ohio-Michigan boundary line with the representatives of the United States geological survey. The governor may accept or reject the work of the United States Geological Survey and if he finds it necessary to have an assistant in this work he may employ a competent person and pay him a reasonable compensation out of the appropriation. This appropriation shall include one-half of the cost of surveying and monumenting Ohio-Michigan boundary, \$27,500.00.

* * * *

Sec. 4. The sums set forth in the column designated "items" in sections 2 and 3 of this act opposite the several classifications of detailed purposes shall not be expended for any other purposes except as herein provided. * * * *

Sec. 10. This act shall not take effect until July 1, 1915.

CHARLES D. CONOVER,
Speaker of the House of Representatives.

JOHN H. ARNOLD,
President of the Senate.

Passed May 27, 1915.

Filed in the office of the Secretary of State at Columbus, Ohio, on the 5th day of June, A. D. 1915.

* * * *

House Bill No. 701 (with exceptions not including the above, C. E. S.) is filed herewith in the office of the secretary of state with my approval.

FRANK B. WILLIS,
June 5, 1915. Governor.

Promptly after the foregoing enabling laws were passed, arrangements were made, with the permission of Dr. George Otis Smith, Director of the United States Geological Survey, for the employment of Mr. S. S. Gannett, to act as engineer in executing the field work under the direction of the commission. Mr. Gannett was eminently fitted for this work by his long experience on topographic surveys for the United States Geological Survey and in surveying the Maryland-West Virginia, and North Carolina-Tennessee boundaries, both of which surveys were so well done that they were approved in every detail by the United States Supreme Court.

On July 7, 1915, Messrs. Gannett and W. H. Herron, Geographer in charge of the Central Division, Topographic Branch of the United States Geological Survey, and the Commissioners met in conference at Toledo, Ohio, and devised and adopted the general plan on which the work was prosecuted to completion. Mr. Gannett and party took the field on July 12, and on October 26 following had completed all surveying, including the placing of all monuments, as described in his report following.

The previous uncertainty of the exact location of the state boundary, due to the disappearance of all original monuments, had caused considerable uneasiness, especially near the eastern end of the line in the vicinity of Toledo, where land has been rapidly increasing in value.

Little difficulty was encountered in establishing the line throughout its entire length. Such matters as were questionable were settled by joint conferences of the commissioners and engineer during the progress of the work, at Pioneer on July 26, and at Toledo on September 13, 1915. Agreement was reached in all cases on the work of the engineer which is formally approved as presented in Part II herewith, and on the nine maps attached hereto. The maps are hereby certified to be true productions of the originals now on file in the archives of the Ohio Archaeological and Historical Society. A description of each monument is given in the engineer's report, and the accompanying photographs and cuts show their general appearance. The posts are numbered consecutively, from the western terminal (initial) monument, toward Lake Erie.

The work of computing the geographic positions of the monuments, and the drawing of the maps was done at Toledo by Mr. Gannett

assisted by C. A. Campbell and L. L. Linton. The copies of the engineer's nine original maps herewith reproduced were prepared in Columbus, by Prof. W. D. Turnbull of Ohio State University, assisted by Mr. Campbell.

The completion of the field work and the setting of the big monument, marked post 70, was celebrated with appropriate ceremonies under the auspices of the Toledo Society of Engineers at the site of the monument on November 24, 1915. At the exercises Ohio was represented by Governor Willis, President Wright of the Ohio State Archaeological and Historical Society, President W. F. Schepflin of the Ohio Engineering Society, Captain Orrin Henry of the State Land Office, and Prof. C. E. Sherman of the Ohio Topographic Survey. Michigan was represented by Governor Ferris, Rt. Rev. Msgr. F. A. O'Brien of the Michigan Historical Commission, Hon. Junius E. Beal of the Public Domain Commission, Prof. C. T. Johnson of the Michigan Engineering Society, and State Geologist, R. C. Allen.

To complete this report the commissioners engaged Mr. Arthur M. Schlesinger, Assistant Professor of American History at Ohio State University, to prepare historical matter which is appended hereto as Part III. Professor Schlesinger has carefully examined the documents relating to the boundary line, and has made an especial study of the early maps which were the cause of the later controversy. Facsimile copies of those portions of Mitchell's map of 1755 and Hutchin's map of 1778 which show the region between Lakes Erie and Michigan have been reproduced to accompany Part III.

We beg to state that the entire work has been completed at as little expense as consistent with durability. The entire length of line from the western terminal post to post 71 at Lake Erie is 369,182.35 feet as measured by the engineer, or 69.92 miles. The total expense of doing the work, exclusive of putting reports through press, was \$7,197.98, as exhibited in the table on a following page. This is a cost of \$102.94 per mile, which we believe to be one of the least expensive boundary relocations ever made, considering the high quality of the results obtained.

While comparisons with other boundary surveys can not be readily made, on account of varying topographic and other conditions, it is interesting to note that the relocation and monumenting of the Ohio-Pennsylvania boundary, 92.72 miles from Lake Erie to Ohio River, was begun in November, 1878, and the last post was not set until August, 1882. About twenty per cent of the original monuments set on this line by Andrew Ellicott in 1786 were found. The cost of doing the work is not stated definitely in the report of the Ohio Commissioners published in 1883, but is known to exceed per mile

MICHIGAN-OHIO BOUNDARY



Views of Post 70 near Eastern Terminus



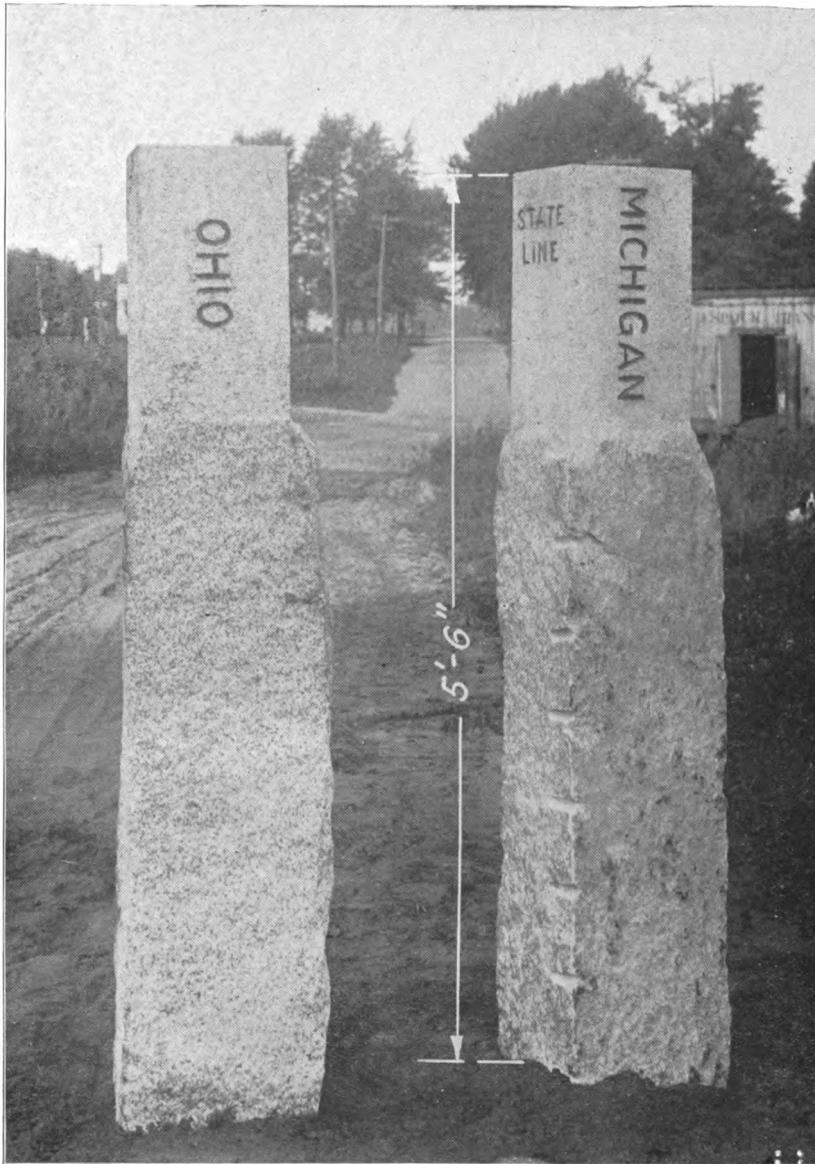
Governor Ferris

Nov. 24, 1915

Governor Willis



MICHIGAN-OHIO BOUNDARY



Intermediate Monuments

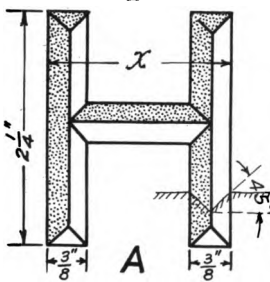
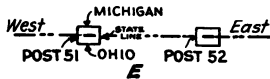


MICHIGAN-OHIO BOUNDARY

DESIGN FOR STONE MONUMENTS

OHIO - MICHIGAN
STATE LINE

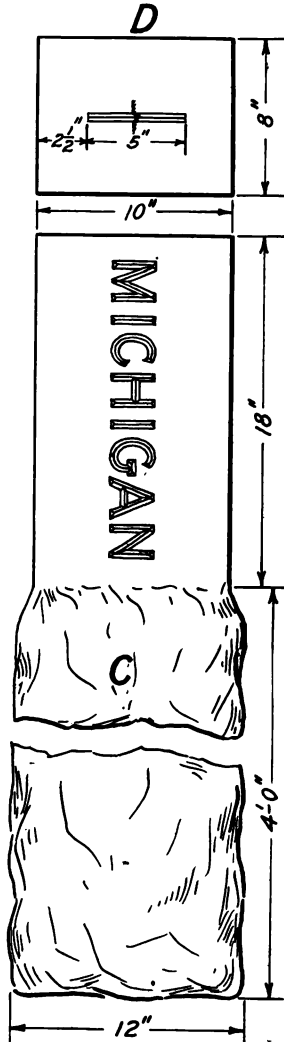
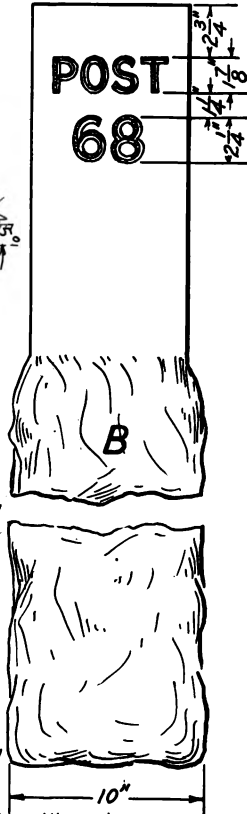
JULY 1915



Material to be 10 inch by 12 inch by 5½ or 6 feet slabs of light gray Barre, Vermont granite or equivalent. Each stone to be dressed to 8 in. by 10 in. section as shown, from the top down for a length of 18 inches. The word OHIO to be lettered on one ten inch face and the word MICHIGAN to be lettered on the opposite ten inch face of each post, both names to read from top down as shown in sketch C, in incised letters of dimensions shown in sketch A.

The word POST with appropriate consecutive number from 1 to 75 to appear in incised letters and figures on 8 in. face as shown in sketch B.

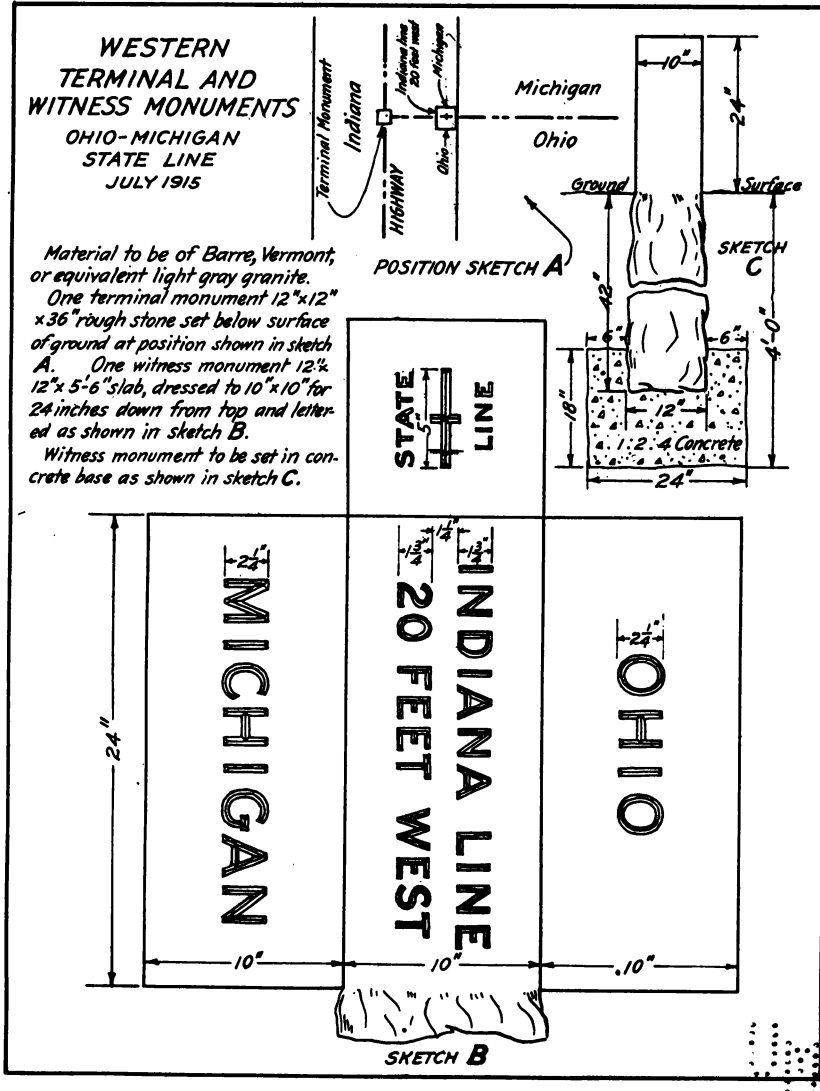
The words STATE on opposite 8 in. face of each post in appropriate sized letters reading horizontally. Top face of each post to be incised with 5 inch groove as shown on sketch D. Relative positions of letters and figures on each post shown in sketch E.



SPECIFICATION FOR INTERMEDIATE POSTS



MICHIGAN-OHIO BOUNDARY



SPECIFICATION FOR WESTERN TERMINAL MONUMENT

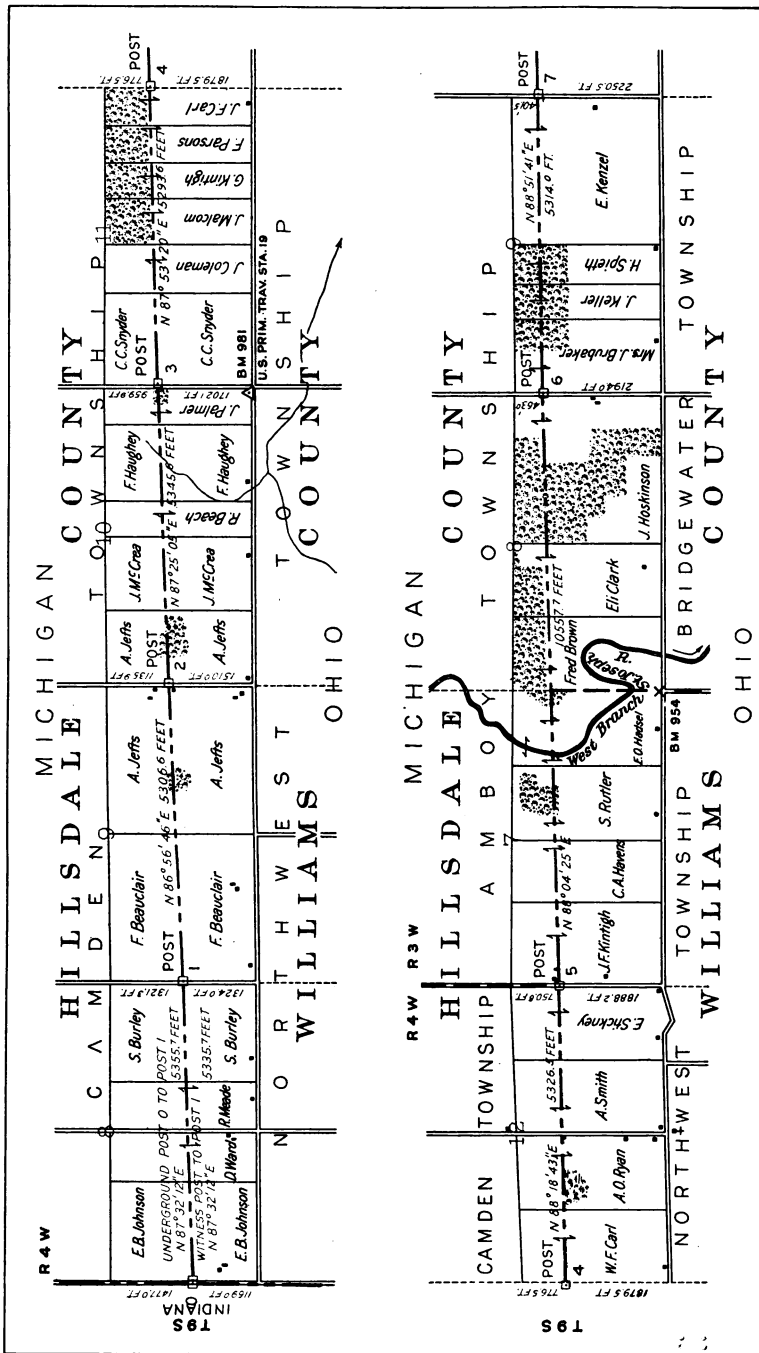


Map No. 1

R.C.Allen, State Geologist
Michigan Geological Survey

OHIO-MICHIGAN BOUNDARY RETRACEMENT

C.E.Sherman, Inspector
Ohio Topographic Survey



Drawn by W.D.Turnbull, C.E.
Columbus, O.-1916.

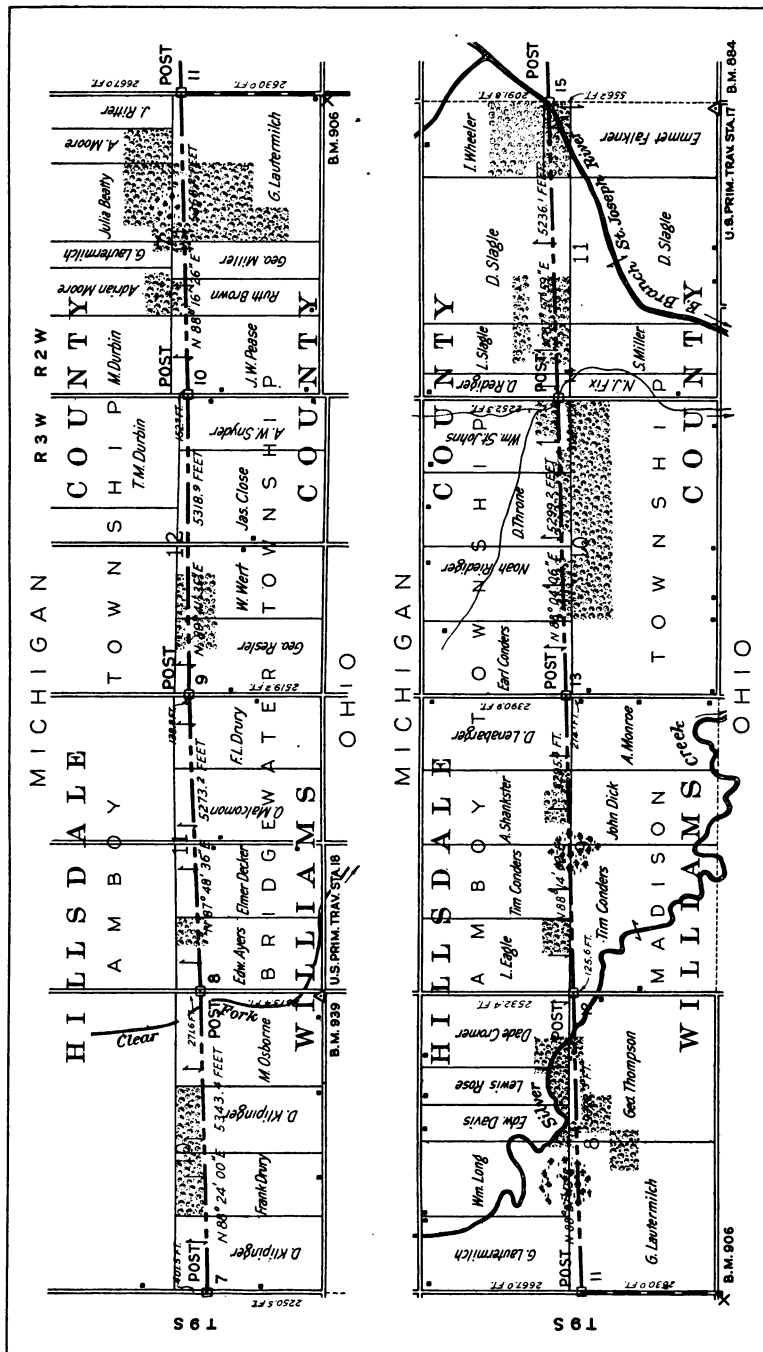
Surveyed in 1915 by S.S.Gannett, Geographer
U.S.Geological Survey

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R.C.Allen, State Geologist
Michigan Geological Survey

C.E. Sherman, Inspector
Ohio Topographic Survey

OHIO-MICHIGAN BOUNDARY RETRACEMENT



Drawn by W. D. Turnbull, C.E.
Columbus, O.-1916

Surveyed in 1915 by S.S.Gannett, Geographer
U.S.Geological Survey.

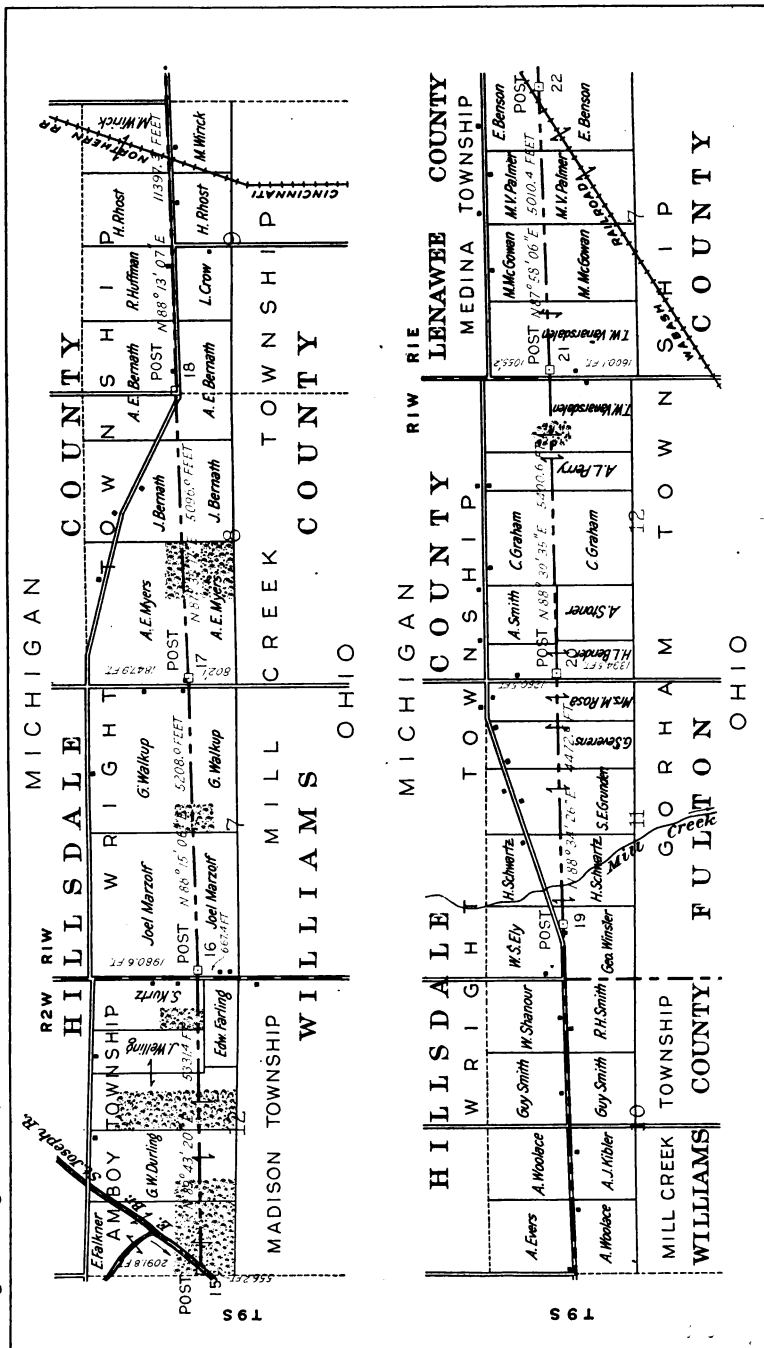


Map No. 3

R.C.Allen, State Geologist
Michigan Geological Survey

C.E.Sherman, Inspector
Ohio Topographic Survey

OHIO-MICHIGAN BOUNDARY RETRACEMENT



Drawn by W.D.Turnbull, C.E.
Columbus, O.-1916.

Surveyed in 1915 by S.S.Gannett, Geographer
U.S.Geological Survey

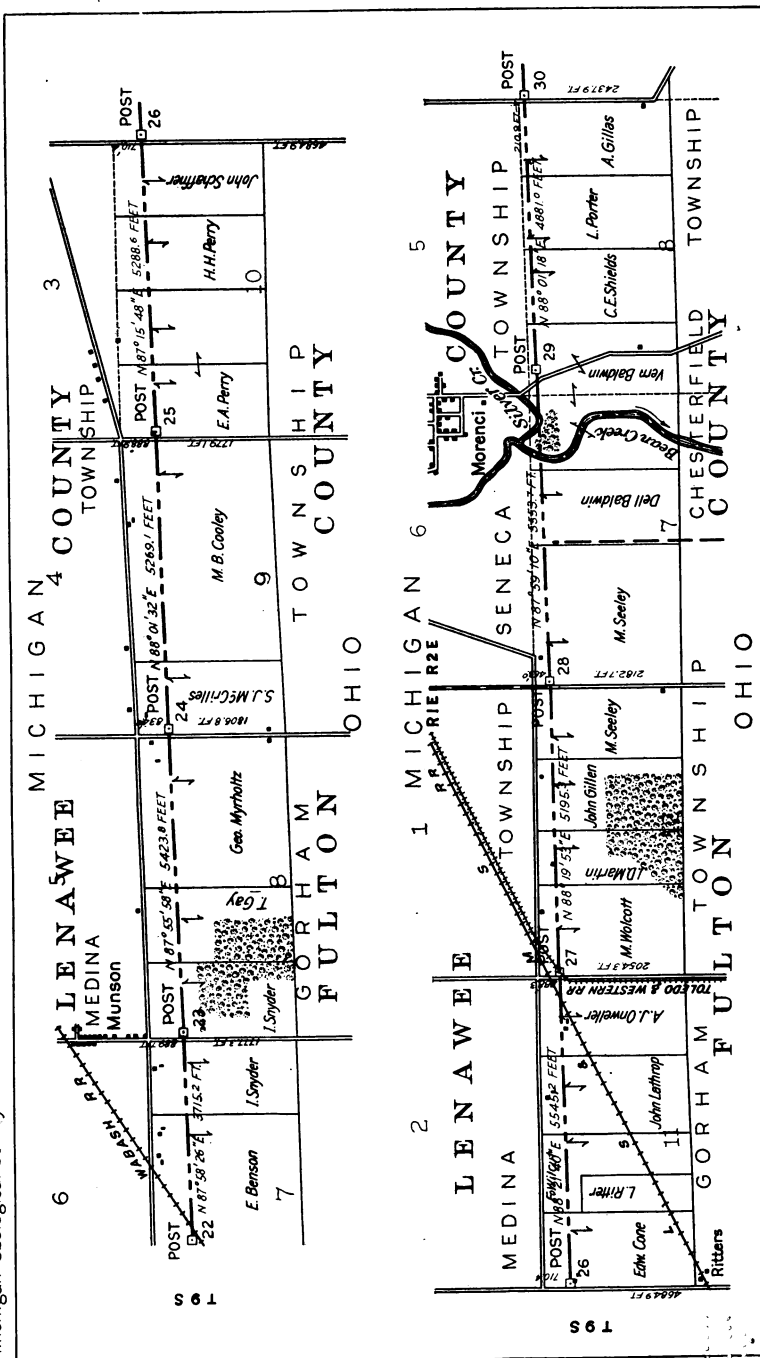


Map No. 4

C.E. Sherman, Inspector
Ohio Topographic Survey

OHIO-MICHIGAN BOUNDARY RETRACEMENT

R.C. Allen, State Geologist
Michigan Geological Survey



Surveyed in 1915 by S.S. Gannett, Geographer
U.S. Geological Survey

Drawn by W.D. Turnbull, C.E.
Columbus, O.-1916.

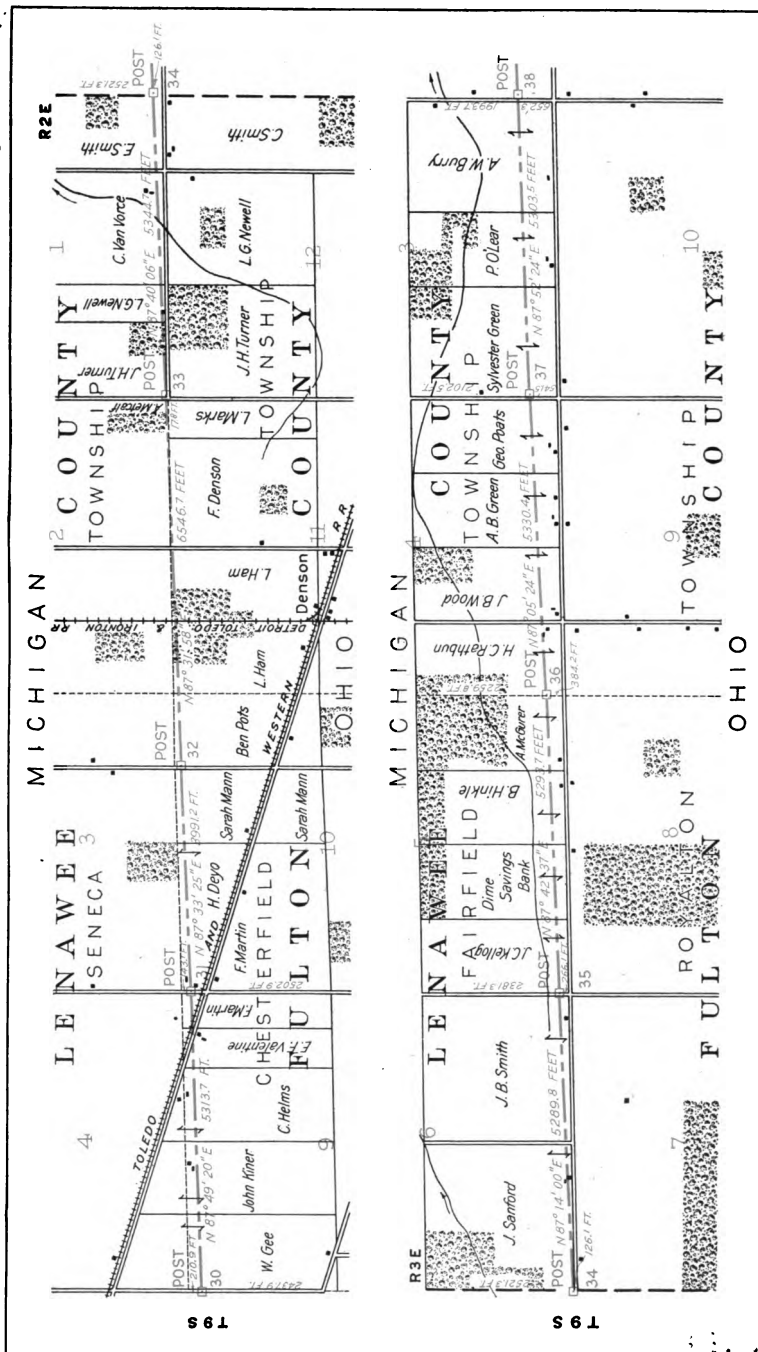


Map No. 5

R.C. Allen, State Geologist
Michigan Geological Survey

OHIO-MICHIGAN BOUNDARY RETRACEMENT

C.E. Sherman, Inspector
Ohio Topographic Survey



Drawn by W. D. Turnbull, C.E.
Columbus, O.-1916.

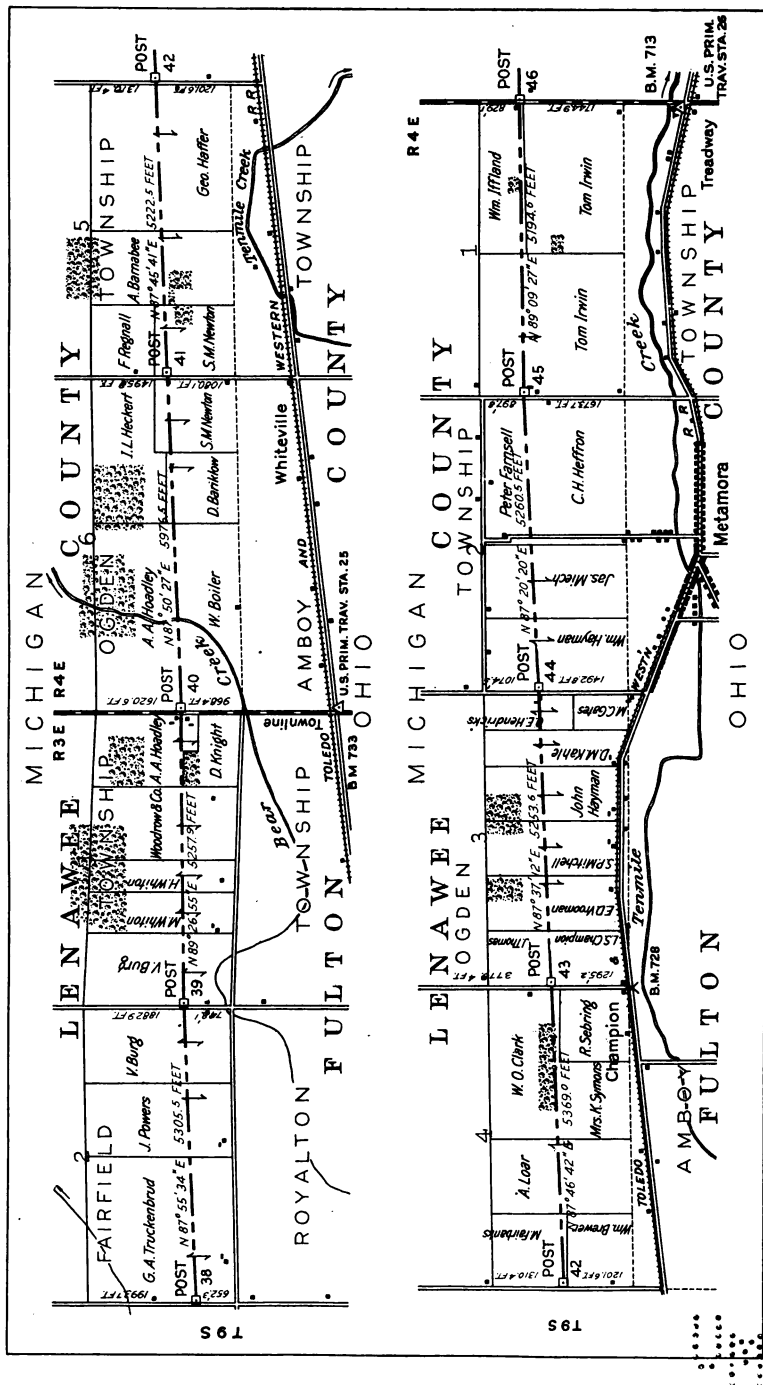
Surveyed in 1915 by S.S. Gannett, Geographer
U.S. Geological Survey



C.E.Sherman, Inspector
Ohio Topographic Survey

OHIO-MICHIGAN BOUNDARY RETRACEMENT

R.C.Allen, State Geologist
Michigan Geological Survey



Surveyed in 1915 by S.S.Gannett, Geographer
U.S.Geological Survey

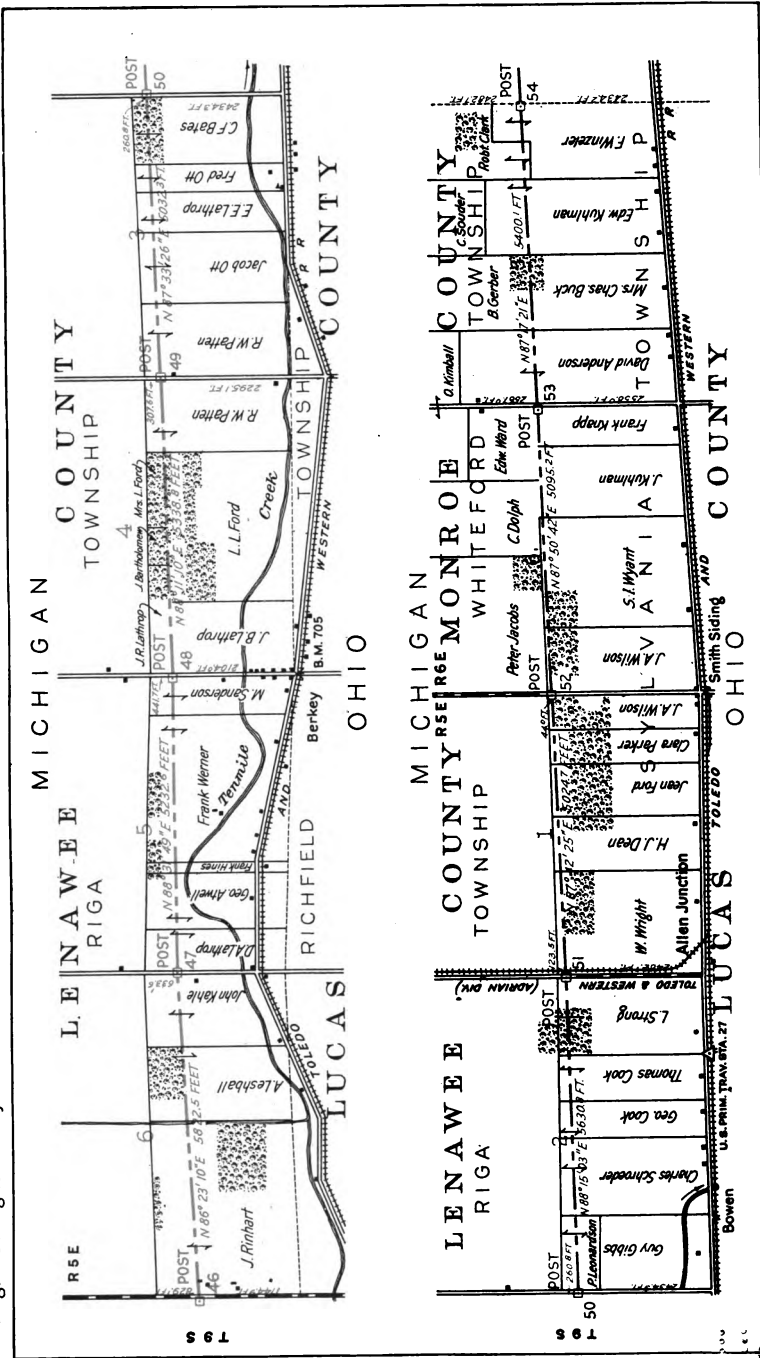
Drawn by W. D. Turnbull, C.E.
Columbus, O.-1916.



R.C.Allen, State Geologist
Michigan Geological Survey

C.E.Sherman, Inspector
Ohio Topographic Survey

OHIO-MICHIGAN BOUNDARY RETRACEMENT



own by W. D. Turnbull, C.E.
Columbus, O.-1916.

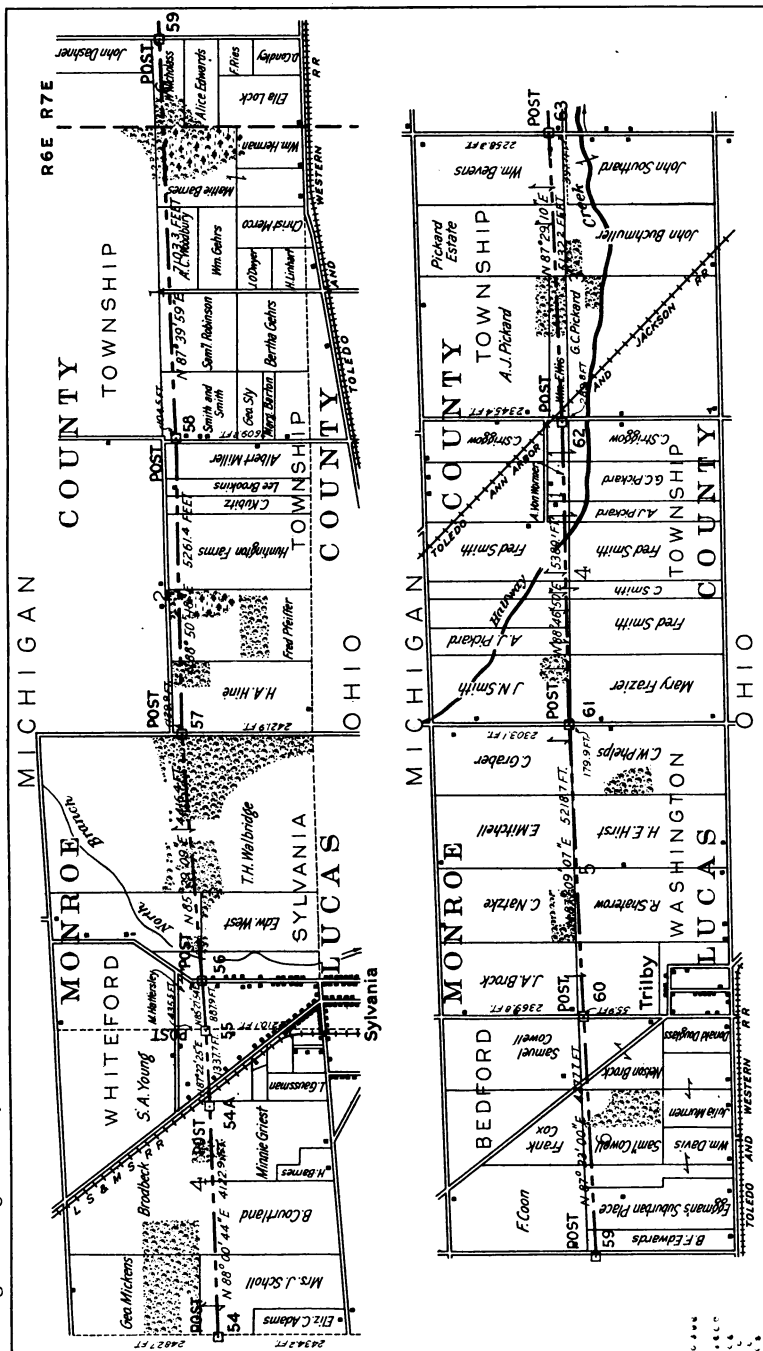
Surveyed in 1915 by S.S.Gannett, Geographer
U.S.Geological Survey



C.E.Sherman, Inspector
Ohio Topographic Survey

R.C.Allen, State Geologist
Michigan Geological Survey

OHIO - MICHIGAN BOUNDARY RETACEMENT.



Drawn by W. D. Turnbull, C.E.
Columbus, O.-1916.

Surveyed in 1915 by S.S.Gannett, Geographer
U.S.Geological Survey

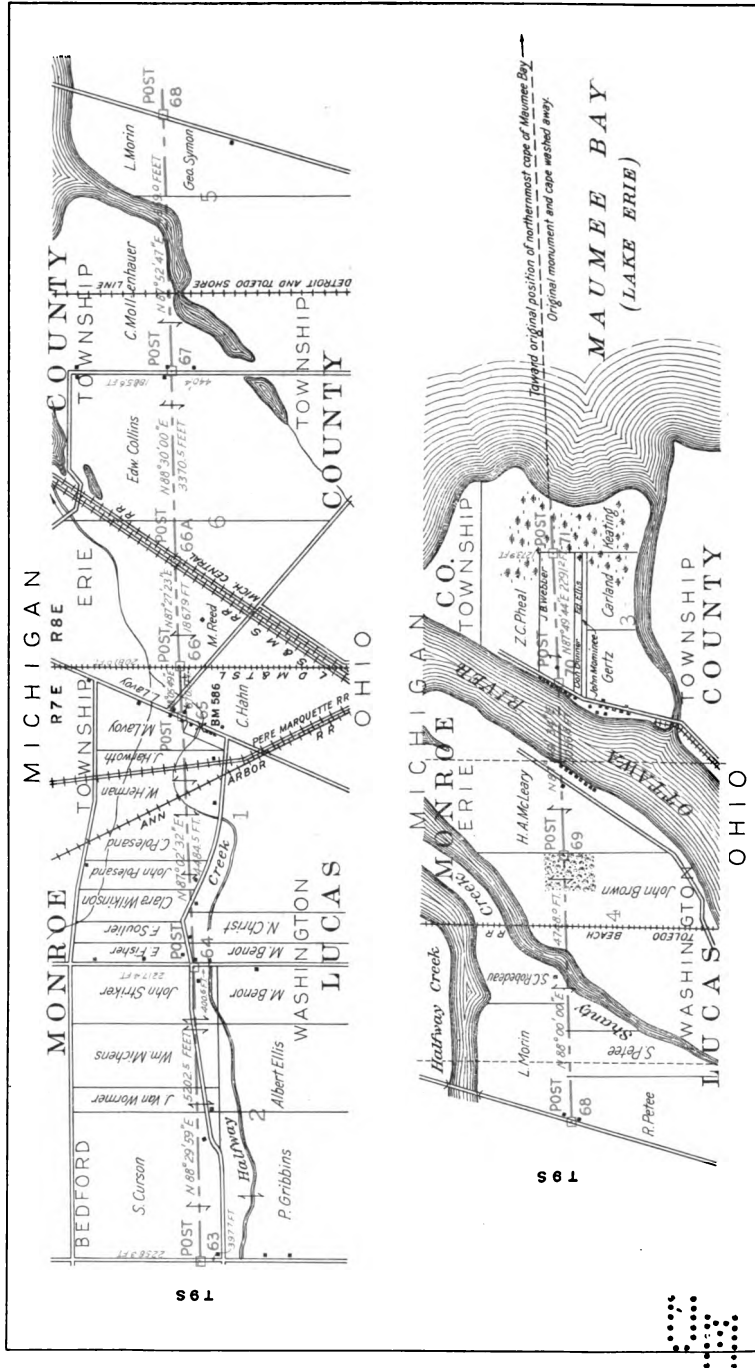
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Map No. 9

R.C. Allen, State Geologist
Michigan Geological Survey

OHIO-MICHIGAN BOUNDARY RETRACEMENT

C. E. Sherman, Inspector
Ohio Topographic Survey



by W. D. Turnbull, C.E.
Columbus, O.-1916.

Surveyed in 1915 by S.S. Gannett, Geographer
U.S. Geological Survey

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that of the present work, and the monuments set are not so substantial as those on the Ohio-Michigan boundary.

Similarly the work of relocating and monumenting the Pennsylvania-Maryland boundary ("Mason and Dixon line") extended over a number of years. The field work began in September, 1900, and the last stone was not set until August, 1903. The report was completed in 1907 and published in 1909. While the length of this line is about 198 miles, only about 66 miles were virtually new work. About 80 per cent of the original monuments were recovered, many being found in the original positions in which they had been set by Charles Mason and Jeremiah Dixon during the years 1763 to 1767.

STATEMENT OF EXPENDITURES MICHIGAN-OHIO JOINT BOUNDARY LINE RESURVEY.

July 1, 1915-June 30, 1916.

Michigan Appropriation.

Payee.	Total.	Salary.	Subsistence.	Travel.	Assistance.	Property, permanent.	Office, incidental.	Miscellaneous.
Allen, R. C.	\$79 67		\$25 50	\$54 17				
Baldwin, Dell	25 50				\$24 50	\$1 00		
Campbell, C. Alfred	191 50	\$100 00	91 50					
Dietz, C. A.	262 50			262 50				
Gannett, Samuel S.	1,588 54	1,325 00	216 00	59 85		57 22	\$30 47	
Jackson, R. B.	153 50	80 00	73 50					
Linton, L. L.	241 50	150 00	91 50			\$450 00		
Lloyd Brothers	450 00							
Sherman, C. E.	200 00	200 00						
Sherman, R. B.	134 50	70 00	64 50					
Sorensen, F. G.	112 33	58 33	54 00					
Terry Engraving Co.	108 49					105 99		
Turnbull, W. D.	50 25	50 25						
Total	\$3,598 28	\$1,933 58	\$616 50	\$376 52	\$24 50	\$614 21	\$30 47	
Appropriation	\$3,600 00							
Balance	1 72							
	\$3,600 00							

*Granite monuments.

To complete the work, it remains only for the legislatures of both states to accept the survey and adopt this report by passage of the following or a similar joint resolution:

Whereas, the 81st General Assembly of Ohio in House Bill 701 passed May 27, 1915, and the 48th Legislature of Michigan by Act 84 of Public Acts of 1915, provided for a joint relocation and permanent monumenting of the line between Ohio and Michigan, and

Whereas, this work has been duly executed by the proper officers of both states as evidenced by their report dated July 1, 1916, to the governing authorities of both states, therefore be it

Resolved, that the said boundary line as relocated and monumented under authority of the acts above cited be adopted as the true boundary, and that the work of the commissioners and their above mentioned report be adopted as final.

All of which is respectfully submitted for your approval and transmission to the respective legislatures.

Very respectfully,

C. E. Sherman

Inspector,
Ohio Topographic Survey.

R. C. Allen.

Director,
Michigan Geological Survey,
Commissioners.

PART II.

REPORT OF ENGINEER.

REPORT OF ENGINEER.

Toledo, Ohio, November 30th, 1915.

Mr. R. C. Allen,
Director Michigan Geological Survey,
Lansing, Michigan.

Professor C. E. Sherman,
Inspector Ohio Topographic Survey,
Columbus, Ohio.

Dear Sirs:—

I have the honor to submit the following report of operations in surveying and monumenting the Michigan-Ohio boundary line during 1915.

A preliminary reconnaissance of the line made early in July, partly in company with Mr. R. C. Allen, Director of the Michigan Geological Survey, disclosed the fact that none of the original marks or posts set by Wm. Harris in 1817, or by Andrew Porter in his resurvey of 1837 of that part of the line through T. 9 S., R. 7 E. to T. 9 S., R. 4 W.; or by John Mullett in his resurvey of 1842 of that part of the line through T. 9 S., R. 8 E., were in existence.

The western terminus of the line, the northwest corner of Ohio, was identified by a boulder or "niggerhead" buried about 2 feet below the surface of road bed, pointed out by residents of that locality as being an undisputed point. The eastern terminus of the line, originally the most northerly cape of Maumee Bay, has been washed away for many years and did not furnish a definite starting point; neither were there other permanent or semi-permanent marks near the eastern terminus, as well defined as the western terminus.

It was therefore evident that the survey of 1915 could best begin at the northwest corner of Ohio. The party was organized at Pioneer, Ohio, July 12th as follows:

S. S. Gannett, Geographer U. S. Geological Survey,—in charge.
L. L. Linton, of Michigan, Recorder.
C. Alfred Campbell, of Ohio, Rear Chainman.
F. G. Sorensen, of Ohio, Head Chainman.
R. B. Jackson, of Michigan, Rear Rodman.
R. B. Sherman, of Ohio, Head Rodman.

The field work of survey began on July 13th and the last monument was set October 26th, 1915. An automobile sufficiently large to transport members of the party with the necessary instruments, was engaged and was used throughout the season. The transportation problem was thus solved in a satisfactory manner and comparatively little time was lost in going to and from work excepting when roads were muddy. Headquarters for field work were made at Pioneer, Ohio; Morenci, Michigan; and Sylvania, Ohio. The office work was done at Toledo, Ohio.

BOUNDARY LINES.

OHIO.

Ohio was the first state formed from the original Territory Northwest of the River Ohio. It was admitted as a state on November 29, 1802, with limits given in the enabling act as follows:

Bounded on the east by the Pennsylvania line, on the south by the Ohio River to the mouth of the Great Miami River, on the west by the line drawn due north from the Great Miami aforesaid, and on the north by an east and west line drawn through the southerly extreme of Lake Michigan, running east after intersecting the due north line aforesaid, from the mouth of the Great Miami until it shall intersect Lake Erie or the Territorial line, and thence with the same through Lake Erie to the Pennsylvania line aforesaid; Provided, That Congress shall be at liberty at any time hereafter either to attach all the territory lying east of the line to be drawn due north from the mouth of the Miami aforesaid to the Territorial line, and north of an east and west line drawn through the southerly extreme of Lake Michigan, running east as aforesaid to Lake Erie, to the aforesaid state, or dispose of it otherwise, in conformity to the fifth article of compact between the original states and the people and states to be formed in the territory northwest of the river Ohio. (Seventh Congress, first session.)

In the constitution of Ohio of 1802, Article 7, the boundaries are defined as follows:

Bounded on the east by the Pennsylvania line, on the south by the Ohio river to the mouth of the Great Miami River, on the west by the line drawn due north from the mouth of the Great Miami aforesaid, and on the north by an east and west line drawn through the southerly extreme of Lake Michigan, running east after intersecting the due north line aforesaid from the mouth of the Great Miami until it shall intersect Lake Erie or the Territorial line and thence with the same through Lake Erie to the Pennsylvania line aforesaid; provided always and it is hereby fully understood and declared by this convention, that if the southerly bend or extreme of Lake Michigan should extend so far south that a line drawn due east from it should not intersect Lake Erie, or if it should intersect the said Lake Erie east of the mouth of the Miami River of the Lake, then and in that case, with the assent of the Congress of the United States, the northern boundary of this state shall be established by, and extending to, a direct line running from the southern extremity of Lake Michigan to the most northerly cape of the Miami Bay, after intersecting the due north line from the mouth of the Great Miami River as aforesaid; thence northeast to the Territorial line, and by the said Territorial line to the Pennsylvania line.

In accordance with the provisions in the enabling act and in the first constitution of the State, the northern boundary of the State was changed so that, instead of running on a parallel drawn from the southern extremity of Lake Michigan, it followed the arc of a great circle drawn from the southern extremity of Lake Michigan to the most northern cape of Maumee ("Miami") Bay. Following are the texts of the acts providing for the examination of the northern boundary and making the change in the boundary:

AN ACT to provide for the taking of certain observations preparatory to the adjustment of the northern boundary line of the State of Ohio.

That the President of the United States cause to be ascertained by accurate observation, the latitude and longitude of the southerly extreme of Lake Michigan; and that he cause to be ascertained by like observation, the point on the Miami of the lake which is due east therefrom, and also the latitude and longitude of the most northerly cape of the Miami Bay; also that he cause to be ascertained with all practicable accuracy, the latitude and longitude of the most southerly point in the northern boundary line of the United States in Lake Erie, and also the points at which a direct line drawn from the southerly extreme of Lake Michigan to the most southerly point in said northern boundary line of the United States will intersect the Miami River and Bay; and also that he cause to be ascertained by like observation, the point in the Mississippi which is due west from the southerly extreme of Lake Michigan; and that the said observations be made and the result thereof returned to the proper Department within the current year. (Twenty-second Congress, first session, 1832.)

AN ACT to establish the northern boundary line of the State of Ohio, and to provide for the admission of the State of Michigan into the Union.

The northern boundary line of the State of Ohio shall be established at and shall be a direct line drawn from the southern extremity of Lake Michigan to the most northerly cape of the Maumee (Miami) Bay after that line, so drawn, shall intersect the eastern boundary line of the State of Indiana; and from the said north cape of the said bay northeast to the boundary line between the United States and the province of Upper Canada, in Lake Erie, and thence, with the said last mention line, to its intersection with the western line of the State of Pennsylvania. (Twenty-fourth Congress, first session, 1836.)

The northern boundary was originally surveyed in 1817 by Wm. Harris. The western boundary was surveyed in the same year from old Fort Recovery to the northwestern corner. South of Fort Recovery this boundary was surveyed as the first principal meridian of the General Land Office.

MICHIGAN.

Michigan was organized as a territory June 30, 1805, from the northern part of Indiana Territory.

The following clause from the act dividing Indiana Territory defines its limits:

From and after the thirtieth day of June next all that part of the Indiana Territory which lies north of a line drawn east from the southerly bend or extreme of Lake Michigan, until it shall intersect Lake Erie, and east of a line drawn from the said southerly bend through the middle of said lake to its northern extremity, and thence due north to the northern boundary of the United States, shall, for the purpose of

temporary government, constitute a separate territory, and be called Michigan. (Eighth Congress, second session.)

The latter line was run and marked in 1827.

Reduced to its present limits, as described in the following clause from its enabling act, Michigan was admitted to the Union January 26, 1837.

AN ACT to provide for the admission of the State of Michigan into the Union.

Beginning at a point where the above described northern boundary of the State of Ohio intersects the eastern boundary of the State of Indiana, and running thence with the said boundary line of Ohio, as described in the first section of this act, until it intersects the boundary line between the United States and Canada in Lake Erie; thence with the said boundary line between the United States and Canada, through the Detroit River, Lake Huron, and Lake Superior, to a point where the said line last touches Lake Superior; thence in a direct line through Lake Superior to the mouth of the Montreal River; thence through the middle of the main channel of the said river Montreal to the middle of the Lake of the Desert; thence in a direct line to the nearest headwater of the Menominee River; thence through the middle of that fork of the said river first touched by the said line to the main channel of the said Menominee River; thence down the center of the main channel of the same to the center of the most usual ship channel of the Green Bay of Lake Michigan; thence through the middle of Lake Michigan to the northern boundary of the State of Indiana, as that line was established by the act of Congress of the nineteenth of April, eighteen hundred and sixteen; thence due east with the north boundary line of the said State of Indiana to the northeast corner thereof; and thence south with the east boundary line of Indiana to the place of beginning. (Twenty-fourth Congress, first session.)

The above boundaries remain unchanged.

ORIGINAL SURVEY.

The boundary line between Michigan and Ohio was originally surveyed in July and August, 1817, by Wm. Harris. The record of this survey is contained in manuscript form in the surveying division of the General Land Office, Washington, D. C., presumably written by Harris. The beginning of the record is as follows:

Variation $3^{\circ} 32'$

Commenced at the North Cape of the Miami Bay made a willow corner 11 inches diamr. and marked MT on the north side and O on the south from which corner a point of land bears S. 57° E. 6 or 7 miles and a point off an Island bears S. 60° E. 6 or 7 miles and the north point of the same island bears S. 75° E. 6 or 7 miles. From thence—

Courses & distance.	Miles.
S. $87^{\circ} 42'$ W.	Between the State of Ohio and Michigan Territory.
Chains	
25.00	Along the shore.
	1 Corner in the Bay.

Continued

S. $87^{\circ} 42'$ W.	Between the State of Ohio and Michigan Territory
41.00	passed the bay and enter a prairie.
	2 Set post from which a Locust 24 inches diam. bears N. 39° W. 2.00 lks. Prairie wet and covered with high grass.

Continued

- S. 87° 42' W. Between the State of Ohio and Michigan Territory
 5.00 passed the prairie.
 25.00 to an arm of the bay formed by a creek
 45.51 passed it
 3 Set post from which a Hickory 9 inches diameter bears S. 31°
 W. 22 lks. and an Elm 24 inches diameter bears N. 40° E. 18
 lks. Land level.
 Oak, elm, hickory—good farming land.

The western terminus of the Ohio-Michigan line is described by Harris as follows:

- S. 87° 42' W. Between the State of Ohio and Michigan Territory
 Chains
 33.92 To the N. W. corner of the State of Ohio, the corner a pile of stones
 from which a beech 14 inches diameter bears N. 37° W. 44 lks. and a
 sugar 5 inches diameter bears N. 31° E. 15 lks. and a sugar 9 inches
 diameter bears S. 8° W. 20 lks. Land rich and good for farming.

Harris furnishes no record of how he measured the distance of more than a mile across the bay or one-fourth mile across Ottawa River. It was in the middle of the summer and he must have waded it, triangulated it or guessed the distance. In the resurvey made by John Mullett in February 1842 the bay and rivers were probably frozen and direct measurements across comparatively easy. The description of the mile posts set are also very meager, no statement is made of the size of posts or material from which they were made, excepting for the one at the initial point on North Cape. No map of the Harris line is on file in U. S. General Land Office.

RESURVEYS OF 1837 AND 1842.

That part of the Michigan-Ohio boundary line which passes through T. 9 S., R. 7 E. to T. 9 S., R. 4 W., 66 miles in length, was resurveyed by Andrew Porter, Deputy Surveyor in June, 1837. Four miles in T. 9 S., R. 8 E. near the eastern end of the boundary line were resurveyed by John Mullett, Deputy Surveyor, in February, 1842. During these resurveys 31 or less than half of the original 71 mile posts set by Harris were found. No map showing results of these resurveys is on file in the General Land Office at Washington D. C., excepting the individual township plats showing connections with section and quarter section corners adjacent to the line.

A sample of the notes prepared by Andrew Porter, D. S., follows:

- T. 9 S., R. 7 E. Mer. (Mich.)
 Survey of the State Line between Ohio and Michigan. Var. 3° 36' E.
 through Sec. 1, on line between Ohio & Michigan.
 S. 88° W. pass a small branch, course S. E.
 Chains enter a small wet prairie.
 12.10 pass a small creek, Course N. E.
 27.50
 36.50

40.50	leave prairie and enter a field.
66.00	enter the right edge of Prairie.
72.50	pass it
79.80	Intersect line between Secs. 1 & 2. Set Post in cross roads from which an elm 6 inches diam. bears N. $26\frac{1}{2}^{\circ}$ E. 70 lks. dist. (No other bearing trees.)
N. 11° W.	between Secs. 1 & 2.
11.75	passed W. oak 36 in. dia.
40.00	passed qr. sec. post.
46.00	State line at a post.
79.21	Sec. Cor.
	Land $\frac{2}{3}$ improved S. E. qr. barren prairie. The Monroe and Perrysburg Turnpike passes diagonally through this section. June 1, 1837.

The resurvey of 1842 by John Mullett, D. S., is described by him as follows:

	T. 9 S., R. 8. E. Mer. (Mich.)
	Resurvey of State Line between Ohio and Michigan.
	Var. $2^{\circ} 30'$ E. by satisfactory observation taken in Sec. 6.
	February 17th, 1842.
	Set post at intersection of State Line with line between Ranges 7 and 8 E. from which a B. oak 20 in. dia. bears N. 13° E. 286 lks. dist. and a hickory 9 in. dia. bears S. 33° W. 140 lks. dist.
Course	
N. 2° W.	between ranges 7 and 8.
Chs. Lks.	
6.00	a stream 100 lks. wide course E.
30.00	Road to Maumee S. 22° W.
31.75	Township corner.
	Land rolling, 2nd rate timber, Hickory, Oak, Elm, etc.
	From State Line measured on Range Line
S. 2° E.	between Ranges 7 and 8.
6.27	qr. Sec. post.
7.00	Road to Manhattan, S. 50° E.
21.41	post and Mound.
46.27	Section corner.
	Land level, mostly prairie, 2nd rate.
	T. 9 S., R. 8 E. Mer. (Mich.)
	From post on State Line at intersection of line between Ranges 7 and 8 thence on State Line.
N. $87^{\circ} 42'$ E.	in Sec. 6.
9.50	enter W. Wilkinson's fields and enter Prairie.
20.50	leave W. Wilkinson's.
51.11	Harris 5 mile post.
80.00	line between Secs. 5 and 6 set post at intersec. from which Burr Oak 9 in. in dia. bears S. $\frac{1}{4}^{\circ}$ E. 4.35 lks. dist. and a Hickory 6 in. in dia. bears S. $44\frac{1}{2}^{\circ}$ E. 220 lks. dist.
	Land rolling, second rate, W. $\frac{1}{2}$ mile scattering Oak, Aspen, Elm, etc.
	E. $\frac{1}{4}$ mi. Prairie, 2nd rate.
N. 1° W.	between Secs. 5 and 6.
28.00	Section corner on Town line.
	Land level, 1st rate Prairie.
S. 1° E.	between Secs. 5 and 6.
6.54	to qr. Sec. post and leave Prairie.
15.50	a stream course N. E.
46.54	Section corner.
	Land rolling 2nd rate, timber W. and Burr Oak, Hickory, Elm, etc.

DESCRIPTION OF OPERATIONS.

The usual method of retracing and resurveying a state boundary line is by identifying original marks on the ground, replacing them by

permanent monuments and establishing other permanent monuments between these identified marks.

In this case practically all of the original marks having been destroyed, the following methods, adopted in resurveying the Michigan-Ohio boundary line were agreed to at a conference between R. C. Allen, Director Michigan Geological Survey, C. E. Sherman, Inspector Ohio Topographical Survey, W. H. Herron, Geographer in charge Central Division of Topography, U. S. G. S. and S. S. Gannett, Geographer U. S. G. S., held in Toledo, July 7th; and at another conference in Pioneer, Ohio, July 26th, 1915, those mentioned above being present except Mr. Herron.

(1) As nearly as may be line to be relocated as originally staked out on the ground, and not necessarily run as a straight line from end to end.

(2) Existing monuments, fences, highways or other marks, when agreed to by land owners on both sides as being on the State line, are to be so accepted.

(3) Mr. S. S. Gannett to be in charge of the work as per letter of July 3rd, 1915, from Geo. Otis Smith, Director U. S. Geological Survey.

(4) All expenses of doing the work to be paid on vouchers approved and countersigned by S. S. Gannett.

(5) All July expenses to be forwarded to C. E. Sherman and paid by Ohio on regular U. S. Geological Survey vouchers, rubber stamped or marked "Joint Boundary Survey." Duplicates to be furnished Director Allen.

(6) All August and September expenses to be forwarded on Michigan vouchers to R. C. Allen and paid by Michigan, and duplicates furnished C. E. Sherman.

(7) Subsequent expenses to be apportioned by S. S. Gannett between the two States so that the total cost to the two States of completing the work shall be the same. Duplicates of all expense bills furnished each State.

(8) Field maps of the survey shall be on a scale of 400 feet per inch, showing preliminary line in red ink, and the location with reference thereto of existing monuments, buildings, highways, property lines, and other topographic features (except relief) in black ink.

(9) State line in black ink with distances north and south from adjacent section and one-fourth section lines given.

(10) From this atlas of field sheets (one mile shown on each sheet) and the field notes gathered on the preliminary survey, the points at which monuments shall be planted will be determined by joint conference between S. S. Gannett, R. C. Allen, and C. E. Sherman.

(11) Monuments will then be planted, and final report made by S. S. Gannett to R. C. Allen and C. E. Sherman.

(12) Not less than \$2,000.00 to be reserved for purchase and placing of monuments.

(13) Final position of monuments with true bearings and distances between.

(14) Latitude and Longitude of all monuments given to nearest hundredth of second.

MONUMENTS.

(15) In general, planted at each highway and railway crossing of the state line. In particular, for the first 17 miles as marked upon topographic map at Pioneer conference.

(16) Intermediate monuments planted 4 feet into the ground, bottom surrounded with concrete 12 inches deep, 2 feet square, half a sack of Portland cement to each.

(17) Western terminal monument as per attached drawing.

(18) Where State line lies in an east and west road no monuments to be placed, unless the line angles at some point in the road.

(19) Monuments to placed at all angles in state line.

In most cases the only feasible method was to accept the measurements given in the records of the General Land Office of connections made in 1837 and 1842, between the state line and the nearest section and quarter section corners, north and south. A certified copy of these notes was obtained from the Public Domain Commission of Michigan at Lansing and has been used as the official record upon which the survey of 1915 is based. These connections were compared with the values given on plats obtained from the General Land Office, Washington D. C. and were found to be identical.

One difficulty was quickly encountered in adopting this method; for example according to record of the General Land Office, the surveyor starts at a given section corner in Ohio and measures north a certain distance and fixes a point for the Michigan-Ohio line; according to the same record of the General Land Office he starts from a section corner or quarter section corner in Michigan one mile or one-half mile north of first corner, as the case may be, and measures south the recorded distance and fixes a point for the state line which differs materially from the point fixed from the first measurement. The two measurements fall short or overlap by any amount from 1 foot to 200 feet. Accepting the measurement from the south would locate the line in quite a different place from that located by measuring from the north. After checking the new measurements to be sure they are correct the method usually adopted is to assume the chain used in the old

survey was too long or too short and that the error in distance was thus uniformly distributed throughout the mile, then prorate this error or distribute it according to the fraction of a mile that the state line is north or south of the nearest corner.

Example.—T. 9 S., R. 1 E., Section 11, by General Land Office record from corner sections 10, 11, 14 and 15, it is 4,596.2 feet north to State line and from corner sections 2, 3, 10 and 11 it is 696.9 feet south to State line. The sum of these two measurements is 5,293.1 feet. By measurement of survey of 1915 this distance from corner to corner is 5,395.3 feet, or 102.2 feet longer than by record of General Land Office; 696.9 feet is 13.17% of 5,293.1 feet and should be corrected by 13.17% of 102.2 feet or by + 13.46 feet = 710.36 feet; 4,596.2 feet is 86.83% of 5,293.1 feet and should be corrected by 86.83% of 102.2 feet or by + 88.74 feet = 4,684.94 feet; 4,684.94 feet + 710.36 feet = 5,395.3 feet as measured by 1915 survey. The Michigan-Ohio line is therefore 710.36 feet south of corner sections 2, 3, 10 and 11 and 4,684.94 feet north of corner sections 10, 11, 14 and 15.

INSTRUMENTS.

The following instruments loaned by the U. S. Geological Survey were used in making the survey of 1915. Transit No. 80 (new) with circle 6 inches in diameter graduated to 10 feet spaces and read by vernier to 30 inches; telescope furnished with stadia wires, ratio 1 to 100. Two 300 foot steel tapes graduated to feet throughout. One 100 foot steel tape, with necessary repair outfit. Two red and white iron transit rods 8 feet in length. One stadia rod 13 feet in length, plumb bobs, tally pins, etc., completing the usual equipment for running a transit line.

A double center fore and back sight transit line was run excepting where timber, houses or other obstructions necessitated the turning of deflection angles which were read twice, direct and reverse. This line may be designated by one of several names, trial, reference, random or base line and was kept as near to and as nearly parallel to the original State line as circumstances would permit. This reference line was sometimes north and sometimes south of the boundary, according to the nature of the country and obstacles encountered.

TOPOGRAPHY.

The following topographic maps of the U. S. Geological Survey; Pioneer, Alvordton, Wauseon, Swanton, Toledo and Maumee Bay, included the area under survey and were of material assistance in planning and executing the work. Maps of the four first named quad-

rangles made in 1911, with a contour interval of 10 feet, showing timbered areas in addition to other natural and cadastral features, were found to be very accurate and were especially useful.

Toledo and Maumee Bay quadrangles mapped in 1899 with a contour interval of 20 feet, although they did not show timbered areas and were somewhat out of date from a cultural standpoint were likewise useful.

Near the eastern end of the line three good sized streams, Halfway Creek, Shanty Creek and Ottawa River, which could not be directly measured across with the 300 foot steel tape, were triangulated. Railroads were conveniently located for base measurement near Halfway Creek and Shanty Creek and the line was extended across Ottawa River, 0.3 mile wide, by means of a base measured along the stone road near the east bank of the river. Numerous bungalows and trees near this river added to the difficulty of crossing it.

Most of the country traversed was comparatively level, sloping gradually from the west towards the east; the roughest part being near the western end. The extremes in elevation ranging from 573 feet above sea level at Maumee Bay to 1,050 feet near the northwest corner of Ohio.

At first timber and brush retarded the work; later in the summer cornstalks 10 to 14 feet in height formed the principal obstacle. Care was taken to do as little damage as possible to growing crops; the farmers were interested in having the line permanently established and offered little or no objection to trespassing on private property, tramping down corn, oats and wheat and climbing barbed wire fences. The unusually wet summer caused the members of the party to walk many hours through rain, mud and swamps annoyed by hungry mosquitoes, but comparatively little time was lost.

DISTANCES.

Distances were measured to nearest 1-100 foot with one of the 300 foot steel tapes held horizontally. Distances to nearest foot were carefully checked by stadia readings.

ASTRONOMICAL OBSERVATIONS.

Astronomical observations for azimuth were obtained with the transit by observing Polaris near sundown. Six measurements of the angle between the star and mark were made with the telescope direct and reversed in three positions of the circle. Knowing the latitude of the place of observation and hour angle of Polaris the vertical and horizontal circles on the transit were set and the star easily pointed to long before dark. No artificial light was therefore needed to illumi-

nate the mark or cross hairs. The mark was one of the transit rods held over a station hub tack one-fourth to one-half mile distant east or west. Time was obtained from the master clock of the Western Union Telegraph Co. in Toledo and from the railroads; a mean time Howard watch was compared with standard time as sent daily by telegraph from the U. S. Naval Observatory at Washington. Proper reduction was made for difference in longitude.

Azimuth observations were made at eleven stations along the boundary line 70 miles in length. Tables prepared by the General Land Office were used in reducing the observations. The line being nearly east-west the convergence of meridians is considerable, amounting to 46 inches per mile.

I desire to say in conclusion that the boundary line as laid out and marked in 1915 conforms as nearly as it is possible to make it to the original line, and as located least disturbs the titles of citizens residing along it, and that with very rare exceptions the citizens of both states are satisfied.

The fact that the survey was completed and the final line permanently marked in one season, without using all the funds appropriated is due in no small degree to the zeal and energy of the assistants employed on the work, Messrs. L. L. Linton, C. A. Campbell, F. G. Sorensen, R. B. Jackson and R. B. Sherman. Acknowledgment is also due local surveyors and engineers for maps furnished and favors extended.

To you commissioners representing Ohio and Michigan under whose direct supervision the work was done, I am indebted for many valuable suggestions and instructions and for having accounts settled promptly.

Descriptions of the granite posts together with their geographic positions with true bearings and distances between posts will be found appended herewith.

Yours very truly,
S. S. GANNETT.



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APPENDIX.

GRANITE POSTS.

In marking the line a material has been used which it is believed will last for many years, or even for centuries. Granite monuments $5\frac{1}{2}$ feet in length, 1 foot square, with upper 18 inches dressed 8 by 10 inches, were obtained from a quarry at Mt. Airy, North Carolina and cost \$18.00 each delivered. The material is very hard, light gray in color and should "weather" well in this climate. Each post weighs about 700 pounds but including the bed of concrete, the total weight of each in place exceeds 1,400 pounds. Each post is set 4 feet in the ground so that 18 inches projects above the surface.

The posts are lettered as follows: On north side "Michigan;" on south side "Ohio;" on east side "State Line;" on west side "Post" with appropriate number.

GEOGRAPHIC POSITIONS.

The geographic position of the northwest corner of Ohio had already been determined by the primary traverse work of the U. S. Geological Survey and the value given on page 52, Bulletin 552 U. S. Geological Survey; namely

Latitude $41^{\circ} 41' 46.2''$ Longitude $84^{\circ} 48' 21.1''$ was adopted as the best available for the western terminal or initial post. With this value, using distances and azimuths between posts, determined by the survey of 1915, the geographic positions of posts numbered 1 to 71 inclusive were computed and the results given in the following table. These positions are based upon the same datum as the engraved topographical maps of the U. S. Geological Survey covering northwestern Ohio and southeastern Michigan and agree with those maps.

DESCRIPTION OF GRANITE POSTS.

Western Terminal or Initial Post. At northwest corner of Ohio. This point falling in a public road, it was not practicable to erect a monument projecting above the surface. An underground mark was therefore left as follows: A block of granite 12 by 12 by 40 inches, relacing a boulder or "nigger head" buried two feet deep, on east edge of north-south road. Top of granite block is 12 inches below surface of road, the base is set in a bed of concrete 24 by 24 by 18

inches. This granite block is not marked except by a hole one-half inch diameter drilled three inches deep in center of top. It is 1,169 feet north of center of road east, approximate corner of sections 7, 8, 17 and 18, and 1,477 feet south of fence east, the north property line of E. B. Johnson and quarter corner section 8.

The history of the "nigger head" noted above marking the north-west corner of Ohio was obtained by Professor C. E. Sherman on December 29th, 1914 from Mrs. W. A. Saunders, Montpelier, Ohio, as follows:

The southwest quarter section 8, T. 9 S., R. 4 W., lying partly in Michigan and partly in Ohio, was patented by the United States to Hiram Russell, who sold it to Betsy Johnson (Mrs. Saunders' grandmother) from whom it passed to Aldis Johnson (in two parcels?), who died in 1897 at the age of 77. Aldis Johnson moved on the property in 1841 when Mrs. Harriett Johnson (now living at the age of 80 with her daughter Mrs. W. A. Saunders at Montpelier) was 7 years old.

When the farm just east of Aldis Johnson had surveys made in 1869 they dug up the old rotted stake (about 4 inches of it) from the center of the road and all agreeing that it was the original monument, Aldis Johnson planted a "niggerhead" on top of it, which Mrs. Saunders says was there in the middle of the road in 1881 the last time she was there.

It was well known at that time because young folks used to go there to stand in three states, said Mrs. Saunders. (C. E. SHERMAN.)

Copy made April 22, 1915.

(Latitude 41° 41' 46.20" Longitude 84° 48' 21.10")

To Post 1, true bearing N. 87° 32' 12" E. Distance 5,355.7 feet.

WITNESS POST.

A granite post 5½ feet long, 12 inches square with top dressed 10 inches square for 24 inches down from top. Post is lettered as follows; on north side "Michigan;" on south side "Ohio;" on west side "Indiana Line 20 Feet West;" on top "State Line." The post is set in a bed of concrete 2 feet square and 2 feet deep and is in line with an old rail fence east and is 2 feet west of north-south fence on east side of road and 20 feet N. 87° 32' 12" E. from underground western terminal post. Top of post projects 24 inches above ground. Adjoining property east owned by E. B. Johnson.

(Latitude 41° 41' 46.20" Longitude 84° 48' 20.84")

To Post 1, true bearing N. 87° 32' 12" E. Distance 5,335.7 feet.

POST 1.

On east side of north-south road between Secs. 8 and 9, T. 9 S., R. 4 W. Post of light gray granite 69 inches long 12 inches square with top dressed 8 by 10 inches square for 18 inches down from top. Lettered on north side "Michigan," on south side "Ohio," on east side "State Line," on west side "Post 1." Base of post embedded in concrete top projects 18 inches above ground. Post is 1,324.0 feet north of stone corner of Secs. 8, 9, 16 and 17, and 1,321.3 feet south of quarter corner Secs. 8 and 9. Adjoining property east owned by F. Beauclair. Adjoining property west owned by S. Burley.

(Latitude 41° 41' 48.47" Longitude 84° 47' 10.57")

To Post 2, true bearing, N. 86° 56' 46" E. Distance 5,306.6 feet.

POST 2.

On east side of north-south road between sections 9 and 10 T. 9 S., R. 4 W., 1,135.86 feet south of stone, quarter corner between sections 9 and 10, and 1,510.0 feet north of center of east-west road. Adjoining property east and west owned by A. Jefts.

(Latitude $41^{\circ} 41' 51.26''$ Longitude $84^{\circ} 46' 0.72''$)

To Post 3, true bearing N. $87^{\circ} 25' 05''$ E. Distance 5,345.6 feet.

POST 3.

On east side of north-south road between sections 10 and 11, T. 9 S., R. 4 W., 959.9 feet south of fence east-west, approximate quarter corner sections 10 and 11; 1,702.1 feet north of center of crossroads, approximate corner sections 10, 11, 14 and 15. Adjoining property east owned by C. C. Snyder. Adjoining property west owned by J. Palmer.

(Latitude $41^{\circ} 41' 53.63''$ Longitude $84^{\circ} 44' 50.33''$)

To Post 4, true bearing N. $87^{\circ} 53' 20''$ E. Distance 5,293.6 feet.

POST 4.

On north-south fence line between sections 11 and 12, T. 9 S., R. 4 W., on property of J. F. Carl; 776.5 feet south of east-west fence, approximate quarter corner sections 11 and 12; and 1879.5 feet north of center of east-west road approximate corner sections 11, 12, 13 and 14. Adjoining property east owned by W. F. Carl.

(Latitude $41^{\circ} 41' 55.55''$ Longitude $84^{\circ} 43' 40.60''$)

To Post 5, true bearing N. $88^{\circ} 18' 43''$ E. Distance 5,326.5 feet.

POST 5.

On east side of north-south road between section 7, T. 9 S., R. 3 W., and section 12 R. 4 W., 2 feet west of north-south fence; 750.8 feet south of stone, quarter corner west side section 7; 1,888.2 feet north of approximate southwest corner section 7. Adjoining property east owned by J. F. Kintigh and adjoining property west owned by Mrs. Edw. Stickney.

(Latitude $41^{\circ} 41' 57.09''$ Longitude $84^{\circ} 42' 30.42''$)

To Post 6, true bearing N. $88^{\circ} 04' 25''$ E. Distance 10,557.7 feet.

POST 6.

On east side of north-south road between sections 8 and 9 T. 9 S., R. 3 W., 4 feet west of north-south fence; 463.0 feet south of quarter corner between sections 8 and 9, fence east-west; 2,194.0 feet north of corner sections 8, 9, 16 and 17. Adjoining property east owned by Mrs. John Brubaker and adjoining property west owned by J. W. Hoskinson.

(Latitude $41^{\circ} 42' 0.57''$ Longitude $84^{\circ} 40' 11.33''$)

To Post 7, true bearing N. $88^{\circ} 51' 41''$ E. Distance 5,314.0 feet.

POST 7.

On east side of north-south road between sections 9 and 10 T. 9 S., R. 3 W., on north south fence line if extended (no fence 1915); 401.5 feet south of quarter corner between sections 9 and 10, fence east-west; 2,250.5 feet north of stone, corner of sections 9, 10, 15 and 16. Property east owned by D. Klipinger and property west owned by E. Kenzel.

(Latitude $41^{\circ} 42' 01.61''$ Longitude $84^{\circ} 39' 01.29''$)

To Post 8, true bearing N. $88^{\circ} 24' 00''$ E. Distance 5,343.4 feet.

POST 8.

On east side of north-south road between sections 10 and 11, T. 9 S., R. 3 W., 2 feet west of north-south fence; 28.5 feet north of center of small creek; 271.57 feet south of quarter corner between sections 10 and 11, fence east-west; 2,373.42 feet north of center of crossroads, corner sections 10, 11, 14, and 15. Property east owned by Edward Ayres. Property west owned by M. Osborn.

(Latitude $41^{\circ} 42' 03.08''$ Longitude $84^{\circ} 37' 50.88''$)

To Post 9, true bearing N. $87^{\circ} 48' 36''$ E. Distance 5,273.15 feet.

POST 9.

On east side of north-south road between sections 11 and 12 T. 9 S., R. 3 W., 2.3 feet west of north-south wire fence; 138.8 feet south of quarter corner between sections 11 and 12, fence east; 2,519.2 feet north of center of crossroads, corner of sections 11, 12, 13 and 14. Property east owned by Geo. Resler. Property west owned by F. L. Drury.

(Latitude $41^{\circ} 42' 05.07''$ Longitude $84^{\circ} 36' 41.42''$)

To Post 10, true bearing N. $89^{\circ} 41' 35''$ E. Distance 5,318.9 feet.

POST 10.

On east side of north-south road, between section 7 T 9 S., R. 2 W., and section 12 R. 3 W.; 2.5 feet west of north-south wire fence; 152.7 feet south of quarter corner west side section 7, fence east; 2,489.3 feet north of center of road east, southwest corner of section 7. Property east owned by J. W. Pease. Property west owned by A. W. Snyder.

(Latitude $41^{\circ} 42' 05.35''$ Longitude $84^{\circ} 35' 31.30''$)

To Post 11, true bearing N. $88^{\circ} 16' 26''$ E. Distance 5,368.2 feet.

POST 11.

On east side of north-south road between sections 7 and 8, T. 9 S., R. 2 W.; 1.5 feet west of north-south fence line; 2,630.0 feet north of corner sections 7, 8, 17 and 18, center of crossroads; 2,667.0 feet south of corner sections 5, 6, 7 and 8, center of crossroads. Property east and west owned by G. Lautermilch.

(Latitude $41^{\circ} 42' 06.94''$ Longitude $84^{\circ} 34' 20.57''$)

To Post 12, true bearing N. $88^{\circ} 27' 45''$ E. Distance 5,322.3 feet.

POST 12.

On embankment on east side of north-south road between sections 8 and 9, T. 9 S., R. 2 W.; 1 foot east of north-south wire fence; 126.0 feet north of wire fence east; on line with end of stone road; 1.5 miles north of Pioneer, Ohio. Post is 125.56 feet north of stake and stones, quarter corner between sections 8 and 9; 2,532.44 feet south of corner sections 4, 5, 8 and 9, crossroads. Property east owned by L. Eagle. Property west owned by Dade Cromer.

(Latitude $41^{\circ} 42' 08.34''$ Longitude $84^{\circ} 33' 10.43''$)

To Post 13, true bearing N. $88^{\circ} 14' 02''$ E. Distance 5,295.4 feet.

POST 13.

On east side of north-south road between sections 9 and 10, T. 9 S., R. 2 W.; 1.5 feet west of north-south wire fence; 77.0 feet north of center of small wooden bridge over drain ditch; 274.14 feet north of fence, quarter corner between sections 9 and 10; 2,390.86 feet south of crossroads, corner of sections 3, 4, 9 and 10. Property east owned by Earl Condors. Property west owned by D. Lenabarger.

(Latitude $41^{\circ} 42' 09.95''$ Longitude $84^{\circ} 32' 00.65''$)

To Post 14, true bearing N. $88^{\circ} 04' 06''$ E. Distance 5,299.2 feet.

POST 14.

On east side of north-south road between sections 10 and 11, T. 9 S., R. 2 W.; 2 feet west of north-south rail fence; 303 feet north of center of small bridge; 396.7 feet north of east-west fence, quarter corner between sections 10 and 11; 2,252.3 feet south of crossroads, corner sections 2, 3, 10 and 11. Property east owned by D. Rediger. Property west owned by Wm. St. Johns.

(Latitude $41^{\circ} 42' 11.71''$ Longitude $84^{\circ} 30' 50.83''$)

To Post 15, true bearing N. $87^{\circ} 57' 59''$ E. Distance 5,236.1 feet.

POST 15.

On northwest embankment of east branch St. Joseph River on line between sections 11 and 12, T. 9 S., R. 2 W.; 39 feet north of old rail fence west; 556.2 feet north of fence east, quarter corner between sections 11 and 12; 2,091.8 feet south

of cross roads corner of sections 1, 2, 11 and 12. Property east owned by E. Falkner. Property west owned by I. Wheeler.

(Latitude $41^{\circ} 42' 13.54''$ Longitude $84^{\circ} 29' 41.85''$)

To Post 16, true bearing N. $89^{\circ} 43' 20''$ E. Distance 5,331.4 feet.

POST 16.

On east side of north-south road between section 12 T. 9 S., R. 2 W., and section 7 R. 1 W.; 5 feet north of fence east; 2 feet west of north-south fence; 667.4 feet north of fence east, quarter corner west side section 7; 1,980.6 feet south of stone in center of road east, northwest corner of section 7. Property east owned by Joel Marzolf. Property west owned by S. Kurtz.

(Latitude $41^{\circ} 42' 13.79''$ Longitude $84^{\circ} 28' 31.57''$)

To Post 17, true bearing N. $88^{\circ} 15' 06''$ E. Distance 5,208.0 feet.

POST 17.

On east side of north-south road between sections 7 and 8 T. 9 S., R. 1 W., 2 feet west of north-south fence. Post is in line with north part of A. E. Myers barn. It is 802.1 feet north of east-west fence, quarter corner between sections 7 and 8; 1,847.9 feet south of stone in center of road, corner sections 5, 6, 7 and 8. Property east owned by A. E. Myers. Property west owned by C. Walkup.

(Latitude $41^{\circ} 42' 15.35''$ Longitude $84^{\circ} 27' 22.95''$)

To Post 18, true bearing N. $87^{\circ} 35' 17''$ E. Distance 5,096.0 feet.

POST 18.

On line of center of territorial road extended west; 90.7 feet west of center of road north and rail fence running south which marks line between sections 8 and 9, T. 9 S., R. 1 W. It is on south side of road which runs W. N. W. and is 2 feet north of east-west wire fence. Adjoining property owned by A. E. Bernath.

(Latitude $41^{\circ} 42' 17.46''$ Longitude $84^{\circ} 26' 15.83''$)

To Post 19, true bearing N. $88^{\circ} 13' 07''$ E. Distance 11,397.3 feet.

Note regarding adoption of state line through sections 9 and 10, R. 1 W.

The center of the road through these sections was adopted as state line for the following reasons: (1) By certified copy of notes of 1837, survey by Andrew Porter, D. S., his line follows Indiana road for 11 Chains in west part of section 11 and for whole distance through sections 10 and 9 a total of 170.48 chains = 10,251.68 feet. (2) All property owners on each side of road pay taxes for property on north side to Michigan and on south side to Ohio. (3) See statement Claude P. Stevens of Waldron, Michigan herewith.

Waldron, Michigan, July 31st, 1915.

S. S. Gannett,
Morenci, Michigan.

Dear Sir:

Your letter to the County Clerk has been sent to me for a reply. In answer I would say that the center of the public road in sections 9 and 10, T. 9 S., R. 1 W., $1\frac{1}{2}$ miles south of Waldron is considered the dividing line between Michigan and Ohio. The state of Michigan has repaired the road and built the bridges for more than thirty years but how much longer I cannot tell.

Yours truly,

Claude T. Stevens,
Supervisor.

Original copy of above letter filed in field note book No. 2.

The only thing that conflicts with the above is the fact that measurements of connections of state line with land corners north and south, make the state line 71 feet south of center of road at west side of section 9 and approximately 116 feet south of center of road at east side of section 10.

POST 19.

On line with center of territorial road extended east; 51 feet northeast of northeast corner of log house of Geo. Winsler; 47 feet south of center of road running northeast; 26.5 feet south of wire fence east; 2 feet west of north-south garden fence; on land belonging to Geo. Winsler.

(Latitude $41^{\circ} 42' 20.94''$ Longitude $84^{\circ} 23' 45.65''$)

To Post 20, true bearing N. $88^{\circ} 34' 26''$ E. Distance 4,472.6 feet.

POST 20.

On east side of north-south road between sections 11 and 12, T. 9 S., R. 1 W., and east of ditch; 2 feet north and 38.5 feet east from 10 inch hickory tree which is on west side of the road. Post is 1,250.48 feet south of stone, corner sections 1, 2, 11 and 12; 1,394.52 feet north of quarter corner between sections 11 and 12. Adjoining property east owned by H. L. Bender. Adjoining property west owned by Mrs. M. Rosa.

(Latitude $41^{\circ} 42' 22.04''$ Longitude $84^{\circ} 22' 46.71''$)

To Post 21, true bearing N. $88^{\circ} 30' 35''$ E. Distance 5,400.6 feet.

POST 21.

On east side of road which follows Michigan Meridian, Ranges 1 E. and 1 W. Post is 2.2 feet west of north-south wire fence. The distance measured 3 times along west side of section 7, R. 1 E. showed the excessive error of 144.4 feet in 1 mile and 114.3 feet in the half mile from quarter corner west side of section 7 to corner sections 6 and 7. The land office distance being short. Using the adopted method of prorating this error, Post 21 was set 1,055.22 feet south of stone, corner sections 6 and 7; and 1,600.08 feet north of quarter corner west side section 7. Adjoining property both east and west owned by T. W. Vanarsdalen.

(Latitude $41^{\circ} 42' 23.42''$ Longitude $84^{\circ} 21' 35.54''$)

To Post 22, true bearing N. $87^{\circ} 58' 06''$ E. Distance 5,010.4 feet.

POST 22.

In section 7 T. 9 S., R. 1 E.; 57 feet south of wooden state line sign board on Wabash R. R. and 1 foot south, southeast of fence separating property of the railroad from that of E. Benson.

(Latitude $41^{\circ} 42' 25.17''$ Longitude $84^{\circ} 20' 29.53''$)

To Post 23, true bearing N. $87^{\circ} 58' 26''$ E. Distance 3,715.2 feet.

POST 23.

On east side of north-south road between sections 7 and 8 T. 9 S., R. 1 E., 0.3 mile south of Munson, Michigan. Post is 6 feet west of 30 inch oak tree and 2.5 feet west of north-south wire fence. It is 889.7 feet south of center of east-west road, approximate corner of sections 5, 6, 7 and 8 and 1,777.3 feet north of fence west, quarter corner sections 7 and 8. Property east and west owned by I. Snyder.

(Latitude $41^{\circ} 42' 26.47''$ Longitude $84^{\circ} 19' 40.58''$)

To Post 24, true bearing N. $87^{\circ} 55' 58''$ E. Distance 5,423.8 feet.

POST 24.

On east side of north-south road between sections 8 and 9 T. 9 S., R. 1 E.; 1.5 feet west of north-south wire fence. Post is 834.2 feet south of center of crossroads, corner sections 4, 5, 8 and 9; 1,806.8 feet north of quarter corner between sections 8 and 9. Property east owned by S. J. McCrilles. Property west owned by Geo. Myrholtz.

(Latitude $41^{\circ} 42' 28.40''$ Longitude $84^{\circ} 18' 29.12''$)

To Post 25, true bearing N. $88^{\circ} 01' 32''$ E. Distance 5,269.1 feet.

POST 25.

On east side of north-south road between sections 9 and 10, T. 9 S., R. 1 E.; 1.8 feet west of wire fence; 888.9 feet south of fence east, accepted for 50 years as section line between sections 3 and 10; 1,779.1 feet north of east-west fence, quarter corner

between sections 9 and 10. Property east owned by E. A. Perry. Property west owned by M. B. Cooley.

(Latitude $41^{\circ} 42' 30.19''$ Longitude $84^{\circ} 17' 19.69''$)

To Post 26, true bearing N. $87^{\circ} 15' 48''$ E. Distance 5,288.6 feet.

POST 26.

On east side of north-south road between sections 10 and 11, T. 9 S., R. 1 E.; 2.3 feet west of north-south wire fence; 26.0 feet north of wire fence west; 710.36 feet south of stone in road opposite fence west, corner sections 2, 3, 10 and 11; 4,684.94 feet north of iron washer above stone in crossroads, corner sections 10, 11, 14 and 15. No evidence of any stone, fence or other mark for quarter corner between sections 10 and 11 and point on state line was determined from the two section corners noted above. Property east owned by Edw. Cone. Property west owned by John Schaffner.

(Latitude $41^{\circ} 42' 32.68''$ Longitude $84^{\circ} 16' 10.04''$)

To Post 27, true bearing N. $88^{\circ} 21' 40''$ E. Distance 5,545.2 feet.

POST 27.

On east side of north-south road between sections 11 and 12, T. 9 S., R. 1 E.; 1.2 feet west of north-south wire fence. Post is 108.5 feet south of center line of track Toledo & Western R. R.; 88.7 feet south and 46.0 feet east of vitrified sewer pipe in which corner fence on west side of road marks limit of right of way Toledo & Western R. R.; 371.0 feet south of center line of track L. S. & M. S. R. R.; 588.3 feet south of iron pin center of road, corner sections 1, 2, 11 and 12. From iron pin, 8 inches below surface of road, it is 33.0 feet southwest to corner fence. Post 27 is 2,054.3 feet north of east-west fence, quarter corner between sections 11 and 12. Property east owned by Miles L. Wolcott. Property west owned by A. J. Onweller.

(Latitude $41^{\circ} 42' 34.24''$ Longitude $84^{\circ} 14' 56.96''$)

To Post 28, true bearing N. $88^{\circ} 19' 53''$ E. Distance 5,195.3 feet.

POST 28.

On east side of north-south road, between section 7, T. 9 S., R. 2 E., and section 12 R. 1 E.; 1.5 feet west of north-south wire fence; 463.0 feet south of stone at west corner sections 6 and 7, R. 2 E. The section corner stone was found 2½ feet below surface of road, vertically over it was placed a cement sewer pipe 18 inches diameter and 2 feet long, with an iron pin 2 inches square and 30 inches long directly over the stone. From stone at section corner it is 57.0 feet N. $64^{\circ} 30'$ E. to soft maple 2 feet in diameter, and 55.4 feet S. 27° E. to soft maple 3 feet in diameter. Post is 2,182.7 feet north of quarter corner west side of section 7; 0.7 mile southwest of Morenci Michigan. Property east and west is owned by M. Seeley.

(Latitude $41^{\circ} 42' 35.73''$ Longitude $84^{\circ} 13' 48.49''$)

To Post 29, true bearing N. $87^{\circ} 59' 10''$. Distance 5,553.7 feet.

POST 29.

On east side of road in northwest quarter of section 8, T. 9 S., R. 1 E.; 0.5 mile south of Morenci, Michigan. Post is 267.1 feet south and 361.5 feet east of iron hub in tile, corner of sections 5, 6, 7 and 8; from iron hub in tile 3.8 feet northeast to blaze on buckeye tree and 19.9 feet west to blaze on butternut tree. Property owned by V. Baldwin.

(Latitude $41^{\circ} 42' 37.65''$ Longitude $84^{\circ} 12' 35.32''$)

To Post 30, true bearing N. $88^{\circ} 01' 18''$ E. Distance 4,881.0 feet.

POST 30.

On east side of north-south road between sections 8 and 9, T. 9 S., R. 2 E. Post is 36.7 feet east and 15.0 feet north of 2 foot hickory tree which is on west side of road. Post is 210.85 feet south of corner of sections 4, 5, 8 and 9, section corner marked by wood stake and bricks below surface of road, in line with fences east

and west. Post is 2,437.85 feet north of quarter between sections 8 and 9. Property east owned by W. Gee. Property west owned by A. Gilles.

(Latitude $41^{\circ} 42' 39.31''$ Longitude $84^{\circ} 11' 31.01''$)

To Post 31, true bearing N. $87^{\circ} 49' 20''$ E. Distance 5,313.7 feet.

POST 31.

On east side of north-south road between sections 9 and 10, T. 9 S., R. 2 E.; 217.0 feet north of center line of track of Toledo & Western R. R.; 143.1 feet south of fence west and row of trees east in line with corner sections 3, 4, 9 and 10. No corner stone found after digging up road. Post is 2,502.9 feet north of fence east-west, quarter corner between sections 9 and 10. Property east owned by H. Deyo. Property west owned by F. Martin.

(Latitude $41^{\circ} 42' 41.30''$ Longitude $84^{\circ} 10' 21.00''$)

To Post 32, true bearing N. $87^{\circ} 33' 25''$ E. Distance 3,991.2 feet.

POST 32.

On east side of north-south road in section 10, T. 9 S., R. 2 E.; 0.25 mile west of north-south line between sections 10 and 11; 99.8 feet south of fence east. Property east owned by Ben Pots. Property west owned by Sarah Mann.

(Latitude $41^{\circ} 42' 42.98''$ Longitude $84^{\circ} 09' 28.43''$)

To Post 33, true bearing N. $87^{\circ} 31' 58''$ E. Distance 6,546.7 feet.

POST 33.

On north side of "T" road east; 34.3 feet east and 17.8 feet north of corner sections 1, 2, 11 and 12, T. 9 S., R. 2 E. Section corner is marked by brick 1 foot below surface of road, in line with fence west. From section corner to center of oak stump (30 inches diameter) 43 feet S. 45° E. Property east owned by J. H. Turner. Property west owned by A. Metcalf.

(Latitude $41^{\circ} 42' 45.76''$ Longitude $84^{\circ} 08' 02.20''$)

To Post 34, true bearing N. $87^{\circ} 40' 06''$ E. Distance 5,344.7 feet.

POST 34.

On north-south wire fence line between section 6, T. 9 S., R. 3 E., and section 1, T. 9 S., R. 2 E.; 126.07 feet north of stone at west corner sections 6 and 7, R. 3 E. Stone is in center of east-west road 1 foot below surface and is in line with fences north and south. Post 34 is 2,521.3 feet south of quarter corner west side section 6. Property east owned by J. Sanford. Property west owned by E. Smith.

(Latitude $41^{\circ} 42' 47.90''$ Longitude $84^{\circ} 06' 51.79''$)

To Post 35, true bearing N. $87^{\circ} 14' 00''$ E. Distance 5,289.8 feet.

POST 35.

On east side of north-south road between sections 5 and 6, T. 9 S., R. 3 E.; 266.1 feet north of stone near center of crossroads corner sections 5, 6, 7 and 8; 2,381.3 feet south of quarter corner between sections 5 and 6. Post is 1.5 feet west of north-south wire fence and 11.9 feet north of 12 inch burr oak tree. Property east owned by J. C. Kellogg. Property west by J. B. Smith.

(Latitude $41^{\circ} 42' 50.42''$ Longitude $84^{\circ} 05' 42.13''$)

To Post 36, true bearing N. $87^{\circ} 42' 37''$ E. Distance 5,293.7 feet.

POST 36.

On north-south wire fence, line between sections 4 and 5, T. 9 S., R. 3 E.; on line between property of A. McGurer west and H. C. Rathbun east. Post is 384.2 feet north of the corner of sections 4, 5, 8 and 9 which was marked by old wood stake in center of three stones 1.5 feet below surface of east-west road and in line with north-south fence. Replaced wood stake with an iron pin 1 inch square and 1 foot long. Post is 2,259.8 feet south of quarter corner between sections 4 and 5.

(Latitude $41^{\circ} 42' 52.50''$ Longitude $84^{\circ} 04' 32.39''$)

To Post 37, true bearing N. $87^{\circ} 05' 24''$ E. Distance 5,330.4 feet.

POST 37.

On east side of north-south road between sections 3 and 4, T. 9 S., R. 3 E.; 1 foot west of north-south wire fence. Post is 541.5 feet north of center road, approximate corner of sections 3, 4, 9 and 10 and 2,102.5 feet south of quarter corner between sections 3 and 4. Property east owned by Sylvester Green. Property west owned by Geo. Poats.

Note: Dug hole 3 feet deep and 10 feet in diameter but could not find stone or other mark for corner of sections 3, 4, 9 and 10.

(Latitude $41^{\circ} 42' 55.17''$ Longitude $84^{\circ} 03' 22.20''$)

To Post 38, true bearing N. $87^{\circ} 52' 24''$ E. Distance 5,303.5 feet.

POST 38.

On east side of north-south road between sections 2 and 3, T. 9 S., R. 3 E.; 1.5 feet west of north-south wire fence; 652.3 feet north of center of crossroads, approximate corner of sections 2, 3, 10 and 11. Dug hole 2 feet deep and 8 feet diameter for section corner mark but could not find any; 1,993.7 feet south of fence east, quarter corner between sections 2 and 3. Property east owned by G. A. Truckenbrod. Property west owned by A. W. Burry.

(Latitude $41^{\circ} 42' 57.11''$ Longitude $84^{\circ} 02' 12.32''$)

To Post 39, true bearing N. $87^{\circ} 55' 34''$ E. Distance 5,305.5 feet.

POST 39.

On east side of north-south road between sections 1 and 2, T. 9 S., R. 3 E.; 1.3 feet west of north-south wire fence; 748.1 feet north of approximate corner sections 1, 2, 11 and 12, center of road and bridge west. According to oldest inhabitants section corner stone has been lost as corner comes at intersection of Bear Creek with crossroads. Post 1,882.9 feet south of east-west rail fence, quarter corner sections 1 and 2. Property east and west owned by V. Burg.

(Latitude $41^{\circ} 42' 59.00''$ Longitude $84^{\circ} 01' 02.41''$)

To Post 40, true bearing N. $89^{\circ} 26' 55''$ E. Distance 5,257.9 feet.

POST 40.

On east side of north-south road; 1.5 feet west of north-south wire fence. Post is directly east of south wing of Geo. Hoadley's residence and is 968.4 feet north of fence east and center of road west, approximate corner of sections 6 and 7. This section corner is in low wet ground near Bear Creek and mark could not be found. Post is 1,620.6 feet south of quarter corner west side section 6 T. 9 S., R. 4 E. Property east and west owned by A. A. Hoadley.

(Latitude $41^{\circ} 42' 59.49''$ Longitude $83^{\circ} 49' 43.09''$)

To Post 41, true bearing N. $87^{\circ} 50' 27''$ E. Distance 5,976.5 feet.

POST 41.

On east side of north-south road between sections 5 and 6, T. 9 S., R. 4 E.; 3 feet west of north-south rail fence; 1,080.1 feet north of east-west fence stated by L. J. Newton, a resident of many years, as having been accepted as line between sections 6 and 7 and sections 5 and 8. No stone found by digging at corner. Post 1,495.9 feet south of fence west, quarter corner between sections 5 and 6. Property east and west owned by S. M. Newton.

(Latitude $41^{\circ} 43' 01.71''$ Longitude $83^{\circ} 58' 34.34''$)

To Post 42, true bearing N. $87^{\circ} 45' 41''$ E. Distance 5,222.5 feet.

POST 42.

On east side of north-south road between sections 4 and 5, T. 9 S., R. 4 E.; 1.8 feet west of north-south wire fence; 4.3 feet north of an opposite fence running N. 85° E.; 1,201.6 feet north of stone in road corner sections 4, 5, 8 and 9, T. 9 S., R. 4 E.; 1,310.4 feet south of fence west, quarter corner between sections 4 and 5. Property east owned by M. Fairbanks. Property west owned by Geo. Haffer.

(Latitude $41^{\circ} 43' 03.72''$ Longitude $83^{\circ} 57' 25.53''$)

To Post 43, true bearing N. $87^{\circ} 46' 42''$. Distance 5,369.0 feet.

POST 43.

On east side of north-south road between sections 3 and 4, T. 9 S., R. 4 E.; 2 feet west of north-south wire fence; 61.5 feet south of 36 inch elm tree which stands on west side of road; 1,295.2 feet north of fence west, corner sections 3, 4, 9 and 10; 3,778.4 feet south of stone in road, corner of sections 3, 4, 33 and 34. From section corner stone 18.4 feet southwest to hole cut in top of south wing of concrete culvert and 18.5 feet northwest to hole cut in north wing of same culvert. Property east owned by J. Thomas. Property west owned by W. O. Clark. Dug hole 10 feet diameter and 3 feet deep for quarter corner between sections 3 and 4 but no evidence of stone or other mark found. Connection was therefore made with stone at corner of sections 3, 4, 33 and 34 as noted above.

(Latitude $41^{\circ} 43' 05.77''$ Longitude $83^{\circ} 56' 14.79''$)

To Post 44, true bearing N. $87^{\circ} 37' 12''$ E. Distance 5,253.6 feet.

POST 44.

On east side of north-south road between sections 2 and 3, T. 9 S., R. 4 E.; 0.5 mile northwest of Metamora and 1.5 feet east of north-south wire fence. Post is 1,492.8 feet north of stone in road corner sections 2, 3, 10 and 11. Boulder 6 inches below road surface 95.7 feet northeast of northeast corner M. C. Gates house; 45.7 feet northeast of maple tree (four trunks); 76 feet north northeast of 2 foot wild cherry. Post 1,074.5 feet south of stone in road, quarter corner between sections 2 and 3 which is 1 foot below surface of road 2 feet north of wire fence and opposite center line of bridge north; 19.5 feet southwest of mark on top of east wing of bridge and 19.5 feet southeast of mark on top of west wing of bridge. Placed $1\frac{1}{2}$ inch gas pipe and bricks above boulder. Property east owned by Wm. Hayman. Property west owned by O. E. Hendricks.

(Latitude $41^{\circ} 43' 07.92''$ Longitude $83^{\circ} 55' 05.58''$)

To Post 45, true bearing N. $87^{\circ} 20' 20''$ E. Distance 5,260.5 feet.

POST 45.

On east side of north-south road between sections 1 and 2, T. 9 S., R. 4 E.; 1 foot west of north-south wire fence; 0.5 mile northeast of Metamora. Post 1,673.72 feet north of stone in road corner sections 1, 2, 11 and 12. Stone close to surface of road; 20 feet west of anchor post of fence east; S. 85° E. 34 feet to 20 inch elm. Post 897.78 feet south of 2 inch iron pipe, quarter corner between sections 1 and 2. Pipe belled at end, set in bricks, 17.5 feet northeast of center of top of north wing concrete culvert and 35.9 feet west of anchor post of fence east. Property east owned by Tom Irwin. Property west owned by Peter Farnsel.

(Latitude $41^{\circ} 43' 10.33''$ Longitude $83^{\circ} 53' 56.29''$)

To Post 46, true bearing N. $89^{\circ} 09' 27''$ E. Distance 5,194.6 feet.

POST 46.

On west side of north-south road between sections 1, R. 4 E. and 6, R. 5 E., T. 9 S., on north-south fence line; 0.5 mile north of Treadway. Post is 1,744.9 feet north of stone in road, west corner sections 6 and 7. Stone 10 inches below surface in center of road, in line with fence east and west; 26.6 feet east of anchor post of fence west. Post is 829.1 feet south of quarter corner west side of section 6, stone in center of road, 10 inches below surface. In line with fence west; 38.8 feet east of anchor post fence west. Property east owned by J. Rinhart. Property west owned by Tom Irwin. Note.—The fence west, property line between W. Iffland north and Tom Irwin south, and pointed out by them as being approximately on the state line is 65 feet north of state line as determined from the General Land Office record of 1837. Residents (J. Rinhart and Wm. Iffland) agree that said fence is comparatively new and has been moved at least 10 feet north within the last eight years by Tom Irwin in the absence of Wm. Iffland. The General Land Office measurements with error prorated was adopted, as the stone, corner of sections 1 and 6, and stone, quarter corner between sections 1 and 2, were both found. J. H. Rinhart states he has paid taxes on all his buildings in Michigan for 14 years. His house now comes in Ohio, but accepting the fence between Irwin and Iffland referred to above, would locate most of his barn in Ohio also.

(Latitude $41^{\circ} 43' 11.08''$ Longitude $83^{\circ} 52' 47.80''$)

To Post 47, true bearing N. $86^{\circ} 23' 10''$ E. Distance 5,822.5 feet.

POST 47.

On east side of north-south road between sections 5 and 6, T. 9 S., R. 5 E.; 1 foot west of north-south rail fence. Post 633.6 feet south of stone in road, quarter corner between sections 5 and 6. Stone 1 foot below road surface; 25.5 feet east of anchor post of fence west and 29.0 feet from anchor post of fence east. No evidence of corner of sections 5, 6, 7 and 8 found or fence east and west and post was set from quarter corner only. Post 1,385.6 feet north of center line Toledo & Western R. R. tracks; 1,116.6 feet north of center line of bridge over Tenmile Creek. Property east owned by D. A. Lathrop. Property west owned by John Kahle.

(Latitude $41^{\circ} 43' 14.70''$ Longitude $83^{\circ} 51' 31.18''$)

To Post 48, true bearing N. $88^{\circ} 31' 49''$ E. Distance 5,232.6 feet.

POST 48.

On west side of north-south road between sections 4 and 5, T. 9 S., R. 5 E.; opposite wire fence east; 0.5 mile north of Berkey. Post 2,104.0 feet north of corner sections 4, 5, 8 and 9 in Berkey pointed out by six residents as accepted corner. Post 441.7 feet south of stone quarter corner between sections 4 and 5, stone 33.5 feet west from poplar tree on east side of road. On east the state line divides the property of J. B. Lathrop on the south from that of J. R. Lathrop on the north. Adjacent property west owned by M. B. Sanderson. Note.—The state line through section 4, T. 9 S., R. 5 E. has been in dispute for many years. The several landowners on both sides of the line have had numerous law suits and various surveys made to locate a line acceptable to all. About 1907 a fence was built from the west side of section 4 eastward for three-fourths of a mile and adopted as a compromise state line, and has since been accepted by those most interested, viz., J. R. Lathrop, J. B. Lathrop, L. L. Ford and Jean Ford. This fence through section 4 has been adopted by the survey of 1915 as the final line because it is less liable to cause disputes in the future than a line established either north or south of it. It is about 67 feet north of a point on state line on west side of section 4 as determined from General Land Office records and 75 feet north of a point on state line on east side of section 4 determined from the same record.

(Latitude $41^{\circ} 43' 16.02''$ Longitude $83^{\circ} 50' 22.21''$)

To Post 49, true bearing N. $88^{\circ} 11' 10''$ E. Distance 5,338.8 feet.

POST 49.

On east side of north-south road between sections 3 and 4, T. 9 S., R. 5 E.; 1.5 feet west of north-south wire fence. Post 307.6 feet south of stone, quarter corner between sections 3 and 4. Stone at surface of road, 24 feet west of anchor post of fence east and 26.5 feet east of anchor post of fence west. Post 2,295.1 feet north of east-west fence corner sections 3, 4, 9 and 10. Property east and west owned by R. W. Patten.

(Latitude $41^{\circ} 43' 17.68''$ Longitude $83^{\circ} 49' 11.85''$)

To Post 50, true bearing N. $87^{\circ} 33' 26''$ E. Distance 5,032.3 feet.

POST 50.

On east side of north-south road between sections 2 and 3, T. 9 S., R. 5 E. Post 260.82 feet south of stone opposite fence west quarter corner between sections 2 and 3. Post 2,434.3 feet north of approximate corner sections 2, 3, 10 and 11. Dug hole 8 feet by 10 feet, 2 feet deep but found no trace of corner sections 2, 3, 10 and 11. Post 1,831.3 feet north of center line of bridge over Tenmile Creek. Property east owned by Perry Leonardson. Property west owned by C. F. Bates.

(Latitude $41^{\circ} 43' 19.79''$ Longitude $83^{\circ} 48' 05.55''$)

To Post 51, true bearing N. $88^{\circ} 15' 03''$ E. Distance 5,630.8 feet.

POST 51.

On east side of north-south road between sections 1 and 2, T. 9 S., R. 5 E.; 12.7 feet west of west rail Toledo & Western R. R., Adrian branch; 0.5 mile north of Allen Junction. Post is 123.45 feet south of stone, quarter corner between

sections 1 and 2; 2,482.05 feet north of approximate corner sections 1, 2, 11 and 12. Property east owned by W. Wright. Property west owned by L. Strong.

(Latitude $41^{\circ} 43' 21.48''$ Longitude $83^{\circ} 46' 51.33''$)

To Post 52, true bearing N. $87^{\circ} 42' 25''$ E. Distance 5,024.7 feet.

POST 52.

On east side of north-south road between section 1, R. 5 E. and section 6, R. 6 E., T. 9 S.; 0.5 mile north of Smith Siding. Post 44.0 feet south and 22.0 feet east of stone, quarter corner west side of section 6. Adjacent property east and west owned by J. A. Wilson.

(Latitude $41^{\circ} 43' 23.46''$ Longitude $83^{\circ} 45' 45.12''$)

To Post 53, true bearing N. $87^{\circ} 50' 42''$ E. Distance 5,095.2 feet.

POST 53.

On west side of north-south road between sections 5 and 6, T. 9 S., R. 6 E. Opposite old stake found in center of road, stated by Edw. Ward to mark line between his farm and that of F. Knapp; 30.2 feet east of 2 foot elm tree on property line, stated by Frank Knapp and Edw. Ward to have been accepted for 40 years or more as on state line. South 2,558.0 feet to center of crossroads, approximate corner of sections 5, 6, 7 and 8. North 2,567.0 feet to center of crossroads approximate corner sections 5, 6, 31 and 32. State line west divides the property of Edw. Ward on the north and Frank Knapp on the south. Adjacent property east owned by David Anderson.

(Latitude $41^{\circ} 43' 25.35''$ Longitude $83^{\circ} 44' 37.98''$)

To Post 54, true bearing N. $87^{\circ} 17' 21''$ E. Distance 5,400.1 feet.

POST 54.

Two feet west of north-south wire fence on line between sections 4 and 5, T. 9 S., R. 6 E.; 4.5 feet northwest of 20 inch elm. One mile west by 0.5 mile north of Sylvania. Post 2,482.7 feet south of stone, corner sections 4, 5, 32 and 33. Stone 1.8 feet north of center line east-west road on line with north-south fence. Post 2,434.2 feet north of stone, corner sections 4, 5, 8 and 9. Stone 6 inches below surface of road set over another stone and is S. 6° (approximate) W. 47.0 feet from 18 inch hickory and directly south 63 feet from another 18 inch hickory. Post on property of Frank Winzeler. Property east owned by Mrs. J. Scholl.

(Latitude $41^{\circ} 43' 27.87''$ Longitude $83^{\circ} 43' 26.85''$)

To Post 54A, true bearing N. $88^{\circ} 00' 44''$ E. Distance 4,122.9 feet.

POST 54A.

A concrete post of the Lake Shore & Michigan Southern R. R. on west line of railroad right of way in section 4 T. 9 S., R. 6 E. on north line of Sylvania corporation. The post is triangular in shape and projects about 8 feet above ground. Marked "Mich." on north and "Ohio" on south. This post replaces a wooden post set by the same railroad which had been accepted for many years as the state line and as it agreed closely with the line as surveyed in 1915, it has been adopted as a mark on the final line.

(Latitude $41^{\circ} 43' 29.28''$ Longitude $83^{\circ} 42' 32.51''$)

To Post 55, true bearing N. $87^{\circ} 22' 25''$ E. Distance 1,337.7 feet.

POST 55.

On north-south fence line between sections 3 and 4, T. 9 S., R. 6 E.; 0.5 mile north of Sylvania on north boundary of corporation; 435.5 feet south of iron pin in east-west road marking quarter corner between sections 3 and 4. Post 2,210.1 feet north of iron pin, corner sections 3, 4, 9 and 10. Pin 6 inches below surface of east-west road in Sylvania; 37.0 feet east of catch basin; 49.3 feet north of northwest corner M. Crumm's house and 41.6 feet south of south brick wall of K. J. Canfield's house. Property west owned by E. L. Fowler. Property east owned by Mary Hattersley.

(Latitude $41^{\circ} 43' 29.89''$ Longitude $83^{\circ} 42' 14.89''$)

To Post 56, true bearing N. $85^{\circ} 27' 54''$ E. Distance 887.9 feet.

POST 56.

On east side of road running north northeast and south southwest through section 3; T. 9 S., R. 6 E.; 2 feet west of north-south wire fence. Post is on north boundary of Sylvania corporation. Property both east and west owned by Mary Hattersly.
(Latitude $41^{\circ} 43' 30.58''$ Longitude $83^{\circ} 42' 03.22''$)

To Post 57, true bearing N. $85^{\circ} 29' 09''$ E. Distance 4,416.4 feet.

POST 57.

On east side of north-south road between sections 2 and 3, T. 9 S., R. 6 E.; 2 feet west of north-south wire fence and 38.6 feet south of anchor post of fence east. Post is 129.87 feet south of stone, quarter corner sections 2 and 3. Stone in center line north-south road, 31 feet north of north fence of road east. Post is 2,421.93 feet north of stone corner sections 2, 3, 10 and 11. Stone in center line road opposite center line lane east from stone 75.6 feet southeast to 24 inch oak tree and 39.2 feet northeast to 8 inch apple tree. Property east of post 57 owned by H. A. Hine. Property west owned by T. H. Walbridge.

(Latitude $41^{\circ} 43' 34.01''$ Longitude $83^{\circ} 41' 05.16''$)

To Post 58, true bearing N. $88^{\circ} 50' 18''$ E. Distance 5,261.4 feet.

POST 58.

On east side of north-south road between sections 1 and 2, T. 9 S., R. 6 E.; 46.6 feet northwest of northwest corner of A. Shabnow's house; 104.5 feet south of stone, quarter corner between sections 1 and 2. Post 2,509.2 feet north of iron pipe, center line north-south road, opposite fence west, marking corner sections 1, 2, 11 and 12. Post on lot of A. Shabnow. Property west owned by Albert Miller.

(Latitude $41^{\circ} 43' 35.06''$ Longitude $83^{\circ} 39' 55.79''$)

To Post 59, true bearing N. $87^{\circ} 39' 59''$ E. Distance 7,103.3 feet.

POST 59.

On west side of north-south road through section 6, T. 9 S., R. 7 E.; 0.3 mile east of range line, opposite stone in center line of road and fences east-west. Stone in road pointed out by residents as having been accepted for many years as being on state line. Fence east divides property of F. Coon on the north from B. F. Edwards on the south. Line west divides property of John Dashner on the north from Winnifred Nicholass on the south.

(Latitude $41^{\circ} 43' 37.91''$ Longitude $83^{\circ} 38' 22.19''$)

To Post 60, true bearing N. $87^{\circ} 23' 00''$ E. Distance 4,277.7 feet.

POST 60.

On east side of north-south road between sections 5 and 6, T. 9 S., R. 7 E.; 0.5 mile north of Trilby; in line with south side of J. A. Brock's house; 62.7 feet west of west side of same house; 5.6 feet south of 10 inch elm; 55.9 feet north of stone, quarter corner sections 5 and 6, on west side of stone road on edge of ditch opposite large oak tree. Post 2,369.8 feet south of center of crossroads approximate corner sections 5, 6, 31 and 32. Post on property of J. A. Brock. Property west owned by Sam'l Cowell.

(Latitude $41^{\circ} 43' 39.84''$ Longitude $83^{\circ} 37' 25.84''$)

To Post 61, true bearing N. $87^{\circ} 09' 07''$ E. Distance 5,218.7 feet.

POST 61.

On east side of north-south road between sections 4 and 5, T. 9 S., R. 7 E.; 2 feet west of north-south board fence; 179.9 feet north of fence west pointed out by Will Frazier as being on the one-half section line; 2,303.1 feet south of center of crossroads, opposite center line of bridge east, approximate corner sections 4, 5, 32 and 33. Property east owned by J. N. Smith. Property west owned by C. Graber.

(Latitude $41^{\circ} 43' 42.40''$ Longitude $83^{\circ} 36' 17.10''$)

To Post 62, true bearing N. $88^{\circ} 46' 50''$ E. Distance 5,389.1 feet.

POST 62.

On west side of north-south road between sections 3 and 4, T. 9 S., R. 7 E.; 14.5 feet south of south rail of Toledo, Ann Arbor & Jackson R. R.; 15.0 feet east of north-south wire fence and 12.5 feet west of center line of paved roadway. Post 289.78 feet north of east-west fence pointed out as being on one-half section line; 2,345.42 feet south of north corner of sections 3 and 4. Corner marked by wooden stake above stone 2 feet below surface of road. Stake 42.5 feet northwest of telephone pole; 33.7 feet west of 1 foot brace pole; 8.1 feet south east of mail box post; 21.7 feet south of east-west wire fence. Property east owned by Wm. Ellis. Property west. owned by C. Striggow.

(Latitude $41^{\circ} 43' 43.53''$ Longitude $83^{\circ} 35' 06.05''$)

To Post 63, true bearing N. $87^{\circ} 29' 10''$ E. Distance 5,132.2 feet.

POST 63.

On east side of north-south road between sections 2 and 3, T. 9 S., R. 7 E.; 1.2 feet east of north-south wire fence; 397.70 feet north of west fence pointed out by S. Curson as on the one-half section line; 2,258.30 feet south of center of crossroads pointed out by S. M. Koch as the corner of sections 2, 3, 34 and 35. Post on property of S. Curson. Property west owned by Wm. Bevens.

(Latitude $41^{\circ} 43' 45.75''$ Longitude $83^{\circ} 33' 58.43''$)

To Post 64, true bearing N. $88^{\circ} 29' 59''$ E. Distance 5,202.5 feet.

POST 64.

At southwest corner of crossing of north-south road between sections 1 and 2, T. 9 S., R. 7 E. and east-west road through center of sections 1 and 2; 3 feet east of north-south wire fence and 5 feet north of east-west wire fence; 400.6 feet north of stone quarter corner between sections 1 and 2, T. 9 S., R. 7 E. in center line of north-south road, opposite fence west. Stone and stake 20.5 feet east of north-south fence. Post 2,217.4 feet south of center of cross roads, approximate corner sections 1, 2, 35 and 36. Property east owned by C. Tye. Property west owned by John Striker.

(Latitude $41^{\circ} 43' 47.09''$ Longitude $83^{\circ} 32' 49.84''$)

To Post 65, true bearing N. $87^{\circ} 02' 32''$ E. Distance 4,484.5 feet.

POST 65.

On east side of Detroit Ave., in section 1 T. 9 S., R. 7 E.; opposite fence east along north side of church yard, pointed out by Moses Lavoy (resident for 45 years) as having been accepted for many years as state line. Post 2.5 feet west of anchor post of said fence east; 51.7 feet northwest of northwest corner of brick church. Line east divides property of L. Lavoy from church yard. Property west owned by M. Lavoy.

(Latitude $41^{\circ} 43' 49.37''$ Longitude $83^{\circ} 31' 50.78''$)

To Post 66, true bearing N. $88^{\circ} 05' 49''$ E. Distance 870.3 feet.

POST 66.

In section 6, T. 9 S., R. 8 E.; on Detroit, Monroe & Toledo Short Line R. R. right of way; 37.67 feet east of east rail of tracks; 1.5 feet west of north-south wire fence; on line with north fence of cemetery, which is on line with fence along north side of church yard (see Post 65), accepted for many years as state line. Post is 2,081.0 feet south of approximate corner of sections 6 and 31, R. 8 E. Line west divides the property of L. Lavoy from cemetery. Property east owned by M. Reed.

(Latitude $41^{\circ} 43' 49.65''$ Longitude $83^{\circ} 31' 39.31''$)

To Post 66A, true bearing N. $87^{\circ} 27' 23''$ E. Distance 1,867.9 feet.

POST 66A.

A concrete post of the Lake Shore & Michigan Southern R. R. on east side of railroad in section 6, T. 9 S., R. 8 E.; 5 miles northeast of Toledo. The post is triangular in shape, about 18 inches on each side and projects 8 feet above ground; marked "Mich." on north side and "Ohio" on south. This post like post 54A, set

by the same railroad north of Sylvania, has been accepted for many years as on the state line and as it agreed closely with the line as surveyed in 1915, it has been adopted as a mark on the final line.

(Latitude $41^{\circ} 43' 50.47''$ Longitude $83^{\circ} 31' 14.70''$)

To Post 67, true bearing N. $88^{\circ} 30' 00''$ E. Distance 3,370.5 feet.

POST 67.

On east side of north-south road between sections 5 and 6, T. 9 S., R. 8 E.; opposite line of cherry trees east. Post 73.3 feet from southwest corner concrete porch, house of C. Mollenhauer; 440.4 feet north of quarter corner sections 5 and 6, fence east 1,885.6 feet south of north corner sections 5 and 6 fence east pointed out by Nicholas Spross as being on the section line. Property east owned by C. Mollenhauer. Property west owned by Edw. Collins.

(Latitude $41^{\circ} 43' 51.34''$ Longitude $83^{\circ} 30' 30.26''$)

To Post 68, true bearing N. $87^{\circ} 52' 47''$ E. Distance 4,559.0 feet.

POST 68.

On east side of Michigan Ave., in section 5, T. 9 S., R. 8 E.; 2 feet west of anchor post of fence east. Fence said by residents to have been accepted for many years as state line; 58.3 feet southwest of south-west corner L. Morin's house; 42.0 feet southwest of 30 inch oak tree. Line east divides property of L. Morin on the north from R. Petee on the south. Line west divides property of L. Morin on the north from Geo. Symon on the south.

(Latitude $41^{\circ} 43' 53.00''$ Longitude $83^{\circ} 29' 30.17''$)

To Post 69, true bearing N. $88^{\circ} 00' 00''$ E. Distance 4,748.0 feet.

POST 69.

In section 4, T. 9 S., R. 8 E.; 1.25 feet east of north-south wire fence east of timber; 6.3 feet northwest from 30 inch elm. Post replaced a stone 3 inches by 6 inches, 4 inches above ground, said by H. A. McLeary (old resident) to have been set on the state line about 40 years ago. Post on property of H. A. McLeary. Adjacent property west owned by John Brown.

(Latitude $41^{\circ} 43' 54.63''$ Longitude $83^{\circ} 28' 27.59''$)

To Post 70, true bearing N. $87^{\circ} 49' 34''$ E. Distance 3,066.8 feet.

POST 70.

A dressed granite monument, 48 inches by 30 inches by 18 inches, weighing about 2,500 pounds; lettered as follows:

On north side—

MICHIGAN
WOODBRIDGE N. FERRIS
GOVERNOR
ERECTED BY AUTHORITY OF
THE 48TH LEGISLATURE
ACT 84, PUBLIC ACTS OF 1915
BY MICHIGAN GEOLOGICAL SURVEY
R. C. ALLEN, DIRECTOR
JOINTLY WITH THE STATE OF
OHIO

On south side—

OHIO
FRANK B. WILLIS
GOVERNOR
ERECTED BY AUTHORITY OF
THE 81ST GENERAL ASSEMBLY
ACT OF MAY 27, 1915
BY OHIO TOPOGRAPHIC SURVEY
C. E. SHERMAN, INSPECTOR
JOINTLY WITH THE STATE OF
MICHIGAN

On east side—

POST
70

On west side—

STATE
LINE
SURVEYED BY
S. S. GANNETT
GEOGRAPHER
UNITED STATES
GEOLOGICAL SURVEY
1915

The lower part of the monument is embedded for 12 inches into a concrete foundation 36 by 48 by 48 inches, made of 10 sacks of cement and about 40 cubic feet of crushed stone. The foundation thus weighs more than three tons, and is set in sandy soil on property of J. B. Webber, a few feet east of and 20 feet south of northern terminus of stone road to Pt. Place. It is 50 feet east of east bank of Ottawa River and about 5 feet above surface of water. (See Post 71 for method used in locating post 70.)

(Latitude $41^{\circ} 43' 55.78''$ Longitude $83^{\circ} 27' 47.17''$)

To Post 71, true bearing N. $87^{\circ} 49' 44''$ E. Distance 2,291.2 feet.

POST 71.

Granite post 69 inches long, top dressed 6 by 8 inches square and 18 inches down from top; marked "OHIO" on south, "MICHIGAN" on north POST 71 on west, 1915 on east, "STATE LINE" on top. Post set on property of J. B. Webber, 2 feet west of north-south fence dividing property of J. B. Webber and Z. C. Pheatt; 656.6 feet north of fence west, property line of John Momimee and Mr. Carland; 41.6 feet north of fence east; 1,273.9 feet south of fence east-west, south line of section 34; 30.63 feet north of Station 421; 1,986.5 feet. It is in swampy ground, a little more than 900 feet west of shore of Maumee Bay and only a few feet higher than surface of water in the Bay. At the present rate that shore of Bay is being washed away this post should remain undisturbed several hundred years.

(Latitude $41^{\circ} 43' 56.63''$ Longitude $83^{\circ} 27' 16.97''$)

Note.—From hub at Sta. 421 plus 1,986.5 feet it is 626 feet south to east-west fence, pointed out by J. B. Webber as being line between properties of John Momimee and Mr. Carland; the east-west line passing through center of section 3. According to plat of General Land Office dated May 9th, 1843, T. 9 S., R. 8 E., state line passes 10 chains (660.0 feet) north of said east-west center line of section 3. By General Land Office certified notes and also by above plat it is 1,280.4 feet from south line of section 34 south to state line. The line located by the latter measurement comes 9.9 feet south of the location by former. Prorating this error makes location of line 1,273.87 feet south of south line of section 34 and 656.63 feet north of east-west center line of section 3. Accepting this point as the true eastern terminus of the Ohio-Michigan line, Post 71 was set here along the north-south fence crossing the swamp, line between the properties of J. B. Webber and Z. C. Pheatt.

The location for large monument No. 70 was determined by computation, being on the line between Post 71 and the stone pointed out by H. A. McLeary (replaced by Post 69). Monument 70 is 2,291.2 feet S. $87^{\circ} 49' 44''$ W. from Post 71 and 3,066.8 feet N. $87^{\circ} 49' 34''$ E. from Post 69. The true bearing of the line given by Harris in 1817 as well as that given by Mullett resurvey of 1842 is S. $87^{\circ} 42'$ W. and N. $87^{\circ} 42'$ E., agreeing closely with bearings between Posts 69, 70 and 71 given above.

PART III.

BASIS OF THE OHIO-MICHIGAN BOUNDARY DISPUTE.

BASIS OF THE OHIO-MICHIGAN BOUNDARY DISPUTE

ARTHUR MEIER SCHLESINGER.

There has always been an intimate relationship between map-makers and the makers of history. The former class has frequently been instrumental in changing the face of history; the latter has been even more largely responsible for changing the face of maps. An ill-conceived map nerved Christopher Columbus to set sail across the western ocean; the results of his voyage produced a revolution in cartography. It is the purpose of this paper to show to what extent a current misconception of geography made history in the form of the Ohio-Michigan boundary controversy.

Prior to the opening of the long war which made the British the masters of the Ohio valley instead of the French, the standard maps of the western country had been made by the great French cartographers, the De l'Isles, father and son; Jean Baptiste Bourguignon d'Anville; and Nicholas Bellin. These maps, based upon the accounts of the first explorers of that region, were necessarily impressionistic in many particulars.

A new era in map-making opened in 1755 when the British cartographers, stimulated by the ambitions of their government to possess the western country, turned their attention to this work. A flood of maps appeared in that year—as separate sheets, in atlases, and in the popular magazines.¹ Most of these maps plagiarized the work of the French cartographers; but, two of them stood forth as having a character and importance of their own.² These two maps influenced the labors of map-makers for the next half-century. The one, by Lewis Evans of Philadelphia, was hurried through the press in order to be of use in Braddock's ill-fated expedition.³ This map represented chiefly the middle colonies and a part of the backcountry; a small inset showed the northwest region beyond Lake Erie.

The other map, by John Mitchell, played a leading part in the complications and misunderstandings which brought Ohio and Michigan to the verge of war eighty years later. John Mitchell, M. D., F. R. S., was a botanist who came to Virginia early in the eighteenth century.

¹Eleven different maps, apparently by as many different authors, may be found in the Library of Congress for the year 1755.

²Reed, S. M., "British Cartography of the Mississippi Valley in the Eighteenth Century," *Miss. Valley Historical Review*, Vol. 2, pp. 217-222.

³A general map of the middle British colonies, in America; viz. Virginia, Maryland, Delaware, Pennsylvania, New Jersey, New York, Connecticut and Rhode Island. * * * By Lewis Evans. Engraved by Jas. Turner.

His large and elaborate map was undertaken at the request of the Lords of Trade, and was based on "Draughts, Charts and Actual Surveys of different parts of His Majesties Colonies and Plantations in America: Great part of which have been lately taken by their Lordships Orders, and transmitted to this Office by the Governors of the said Colonies."⁴ This map treated the western country in great detail.

Mitchell's map was repeatedly reproduced, widely used and long deemed to be an authority. William Smith, the historian of provincial New York, said of this map: "Dr. Mitchell's is the only authentic one extant. None of the rest concerning America have passed under the examination or received the sanction of any public board, and they generally copy the French."⁵ Its high repute was further evidenced by the fact that it formed the basis of the discussions leading up to the famous proclamation of 1763⁶ and that when, almost twenty years later, the peace commissioners negotiated the treaty for the termination of the Revolutionary War, this map was the only one before them.⁷ Such men as Thomas Kitchin, Eman. Bowen, Thomas Jefferys and William Faden—men whose names were known wherever maps were known in the latter part of the eighteenth century—were map publishers primarily; and they borrowed freely of the labors of the original map-makers, taking to themselves the credit of authorship as well as the profits of publication. Mitchell's map was most widely pirated and may be said to have produced a brood of bastard maps which helped to impress and perpetuate the cartographic errors, as well as excellences, of their progenitor.⁸

Mitchell and his contemporaries had no better conception of the relative positions of Lakes Erie and Michigan than did the earlier French cartographers. It was a misunderstanding of this point that caused all the trouble between Michigan and Ohio in later years. Correct modern maps show that a parallel of latitude (or due east and west line), drawn through the southernmost bend of Lake Michigan, passes about seven miles south of what was formerly the northernmost cape of Maumee Bay. Such a due east line intersects the southern shore of Lake Erie about one-third of a degree east of the mouth of the Maumee river. The French authors had displayed a wide divergence of opinion in this matter. According to Guillaume De l'Isle, a

⁴*A map of the British and French dominions in North America with the roads, distances, limits and extent of the settlements.* By Jno. Mitchell. Thomas Kitchin, sculp. An inscription, signed by Thomas Pownall, secretary of the Plantation Office conveyed the endorsement of the Lords of Trade.

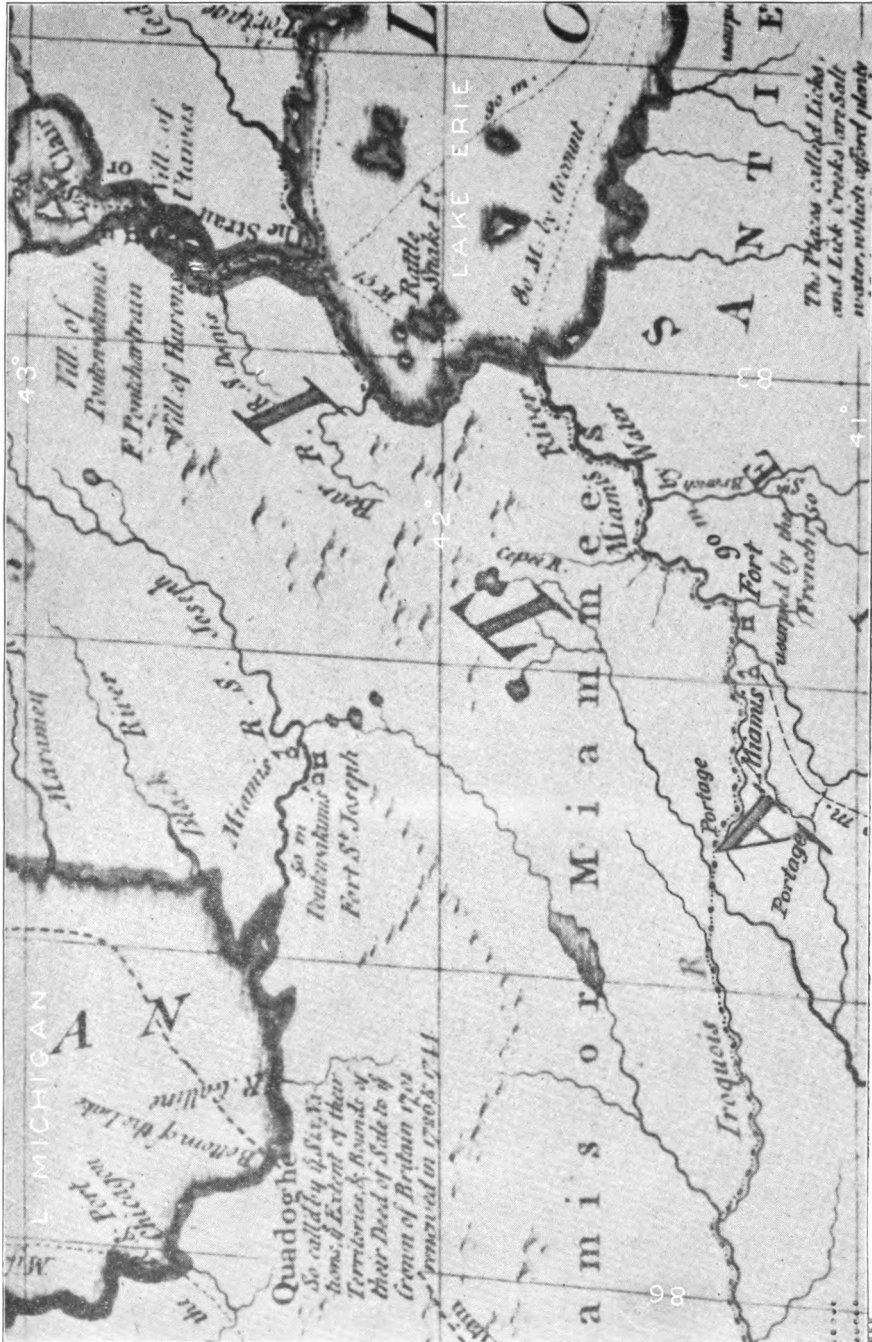
⁵Winsor, *Narrative and Critical History*, vol. 5, p. 83, quoting from Smith, *History of the province of New York* (Albany, 1814), p. 218.

⁶*Report on Canadian Archives*, 1907, No. 18, p. 103n.

⁷*John Adams' Works* (C. F. Adams ed.), vol. 8, pp. 20, 210, 392, 398, 518, 519.

⁸Professor Reed gives a list of such reprints in her article in the *Miss. Valley Historical Review*, vol. 2, pp. 219-220. For a partial list of reprints of Evan's map, see Winsor, *Narrative and Critical Period*, vol. 5, pp. 84-85.

MICHIGAN-OHIO BOUNDARY



Photograph of a portion of Mitchell's Map, 1755.

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MICHIGAN-OHIO BOUNDARY



Photograph of a portion of Hutchins' Map, 1778.



parallel of latitude passing through the southern extremity of Lake Michigan would intersect the blunt end of Lake Erie about halfway between the mouths of the Maumee and the river Raisin.⁹ D'Anville believed that such a parallel would entirely clear the lake to the south.¹⁰ Bellin, through a happy fortune succeeded in drawing his maps so that such a parallel would sever the southern shore of Lake Erie east of the mouth of the Maumee.¹¹ Bellin had chanced upon a close approximation of the true relative position of the two lakes.

Had the British map-makers and publishers used Bellin as a model in this matter, the boundary controversy would never have occurred. Instead, the De l'Isle assumption was taken over in more or less exaggerated form by Mitchell, Evans and their school, though one of the standard atlases, with an excess of that quality which Matthew Arnold termed "sweet reasonableness," followed all three of the French models in as many different maps.¹²

On Lewis Evan's map a due east line drawn from the southernmost point of Lake Michigan would have intersected the western end of Lake Erie some distance north of Maumee Bay. According to Mitchell, it would have crossed the Detroit river above its entrance into Lake Erie. The De l'Isle-Mitchell-Evans misconception dominated map-making to such an extent that the vast majority of maps produced from 1755 until the early decades of the nineteenth century were so constructed as to permit a parallel drawn through the southernmost bend of Lake Michigan to intersect Lake Erie at some point north of the mouth of the Maumee, or to pass the lake entirely on the north. Nor did maps drawn under the supervision of the United States government, and based on actual surveys, improve the situation perceptibly. The map made in 1778 by Thomas Hutchins, of New Jersey, who bore the title of "geographer general in the United States," was not as far wrong as many others, but the due east line in question would have struck Lake Erie near the northern cape of Maumee Bay.¹³ The same was true of a map made in 1784 by William McMurray, "late assistant geographer to the United States."¹⁴

The De l'Isle-Mitchell-Evans misconception as to the relative position of the lakes was widespread as evidenced by its perpetuation on the following maps: de Vaugondy's *Partie de l'Amerique Septent*

⁹*Carte du Canada ou de la Nouvelle France et des decouvertes qui y ont ete faites* * * * Par Guillaume Del l'Isle, geographe de l'Academie Royale des Sciences. 1703.

¹⁰*Amerique Septentrionale*. * * * Par le sr. d'Anville. 1746.

¹¹*Carte des lacs du Canada*. * * * Par N. Bellin, ingenieur et hydrographe de la marine. 1744.

¹²Jefferys, Thomas, *American Atlas* (London, 1776), nos. 2, 5, 7.

¹³*A new map of the western parts of Virginia, Pennsylvania, Maryland and North Carolina, comprehending the rivers Ohio, and all the rivers which fall into it; part of the river Mississippi*

* * * By Thomas Hutchins.

¹⁴*The United States. According to the definitive treaty of peace signed at Paris, September 3, 1783.* By William McMurray. R. Scot, sculp. Mr. P. Lee Phillips, Chief of the Division of Maps and Charts at the Library of Congress, has called this "the first official map of the United States;" *The Rare Map of the Northwest by John Fitch* (Washington, 1916), p. 27.

qui comprend la Nouvelle France ou le Canada (1755); Palairret's *Carte des possessions Angloises & Francoises du continent de l'Amerique* (1759); *An accurate map of North America* * * * by Eman. Bowen and John Gibson (1763); *A map of the British dominions in North America* * * * by Peter Bell (1772); *An accurate map of North America* * * * by Bowen and Gibson (1772); Pownall's *A map of the middle British colonies in North America*. First published by Lewis Evans, of Philadelphia, in 1755; and since corrected and improved * * * (1776); *The British colonies in North America*, engraved by William Faden (1777); *A new map of North America*, engraved for Carver's *Travels through the Interior Parts of North America* (1778); *A map of the United States of North America*, engraved by H. D. Pursell (1785); the same (1787); *A map of the United States of North America*, reproduced in Schopf's *Reise durch einige Mittlern und Sudlichen Vereinigten Nord Amerikanischen Staaten* (1788); the anonymous map, *Sketch of the western countries of Canada* (1791); Conder's *A map of the middle states of America* * * * (1794); *A new map of North America, with the West Indies*, published by Laurie & Whittle (1794); Scott's *N. W. territory* (1795); Bradley's *Map of the northern part of the United States of America* (1797); *A new map of North America* * * * engraved by Hill (1797); *Map of the United States, Canada, etc.*, engraved by Smith and Jones (1799); *Map of the southern, western and middle provinces of the United States*, engraved for Michaux's *Travels to the westward of Alleghany Mountains* (1805); *Map of the United States, including Louisiana*, engraved by Scoles (1810); *The upper territories of the United States*, engraved by Kneass and Delleker (1814); *Map of the United States of America*, published by John Melish (1815); *Map of the United States of America, from Mellishes, with additions and corrections*, engraved by Neele & Son (1818); Lewis's *A new and correct map of the United States of North America* * * * (1819); and *United States*, engraved for Cobbett's *A Year's Residence in the United States of America* (1828).

Thus the misconception was wide-spread and long-enduring. The only exception during this time that the writer has been able to find was *A map of the northwest parts of the United States of America* by the inventor, John Fitch, wherein the relative position of the two lakes was given with approximate correctness. Although published in 1785, Fitch's map was not once referred to by either party in the later boundary controversy.

In view of the almost unanimous testimony of contemporary cartography, it cannot be doubted that in the later eighteenth century and the early years of the nineteenth it was an accepted fact in the best scientific circles, as well as among the people in general, that the southern

extremity of Lake Michigan lay on a parallel of latitude north of Maumee Bay to a greater or less distance. Indeed, the Senate Committee on the Judiciary, which finally effected an adjustment of the difficulties between Ohio and Michigan in 1836, went so far as to say that Mitchell's map, "then considered every where as a map which, in reference to the Northwestern Territory, had no superior for accuracy," was "alleged to have been the very map relied on by Congress, and by the convention of Ohio, at the time of the admission of the State."¹⁵ It is only fair to conclude therefore that when the Ordinance of 1787 described "an east and west line drawn through the southerly bend of Lake Michigan" as a proper boundary between the upper and lower tier of the projected states, the framers had in mind a line that would intersect Lake Erie north of Maumee Bay; or, if Mitchell's map was relied on as authority, the Detroit river above its entrance into the lake.¹⁶ Further, Congress must have intended the same division of territory when the Enabling Act for Ohio (1802) declared that a part of the northern boundary of Ohio should be a line running due east and west "through to the southerly extreme of Lake Michigan." The members of the Ohio constitutional convention were laboring under the same misapprehension, when, an old beaver-trapper appeared on the scene and informed them that the southern shore of Lake Michigan lay much farther south than the maps indicated. Under the circumstances the convention incorporated in the constitution the boundaries described in the Enabling Act, with the proviso that if the southern bend of Lake Michigan extended so far south that a parallel passing through it should not intersect Lake Erie or should pierce the lake east of the mouth of the Maumee, then, with the assent of Congress, the boundary should be "a direct line running from the southern extremity of Lake Michigan to the most northerly cape of the Miami [Maumee] bay."¹⁷ In 1805, when the territory of Michigan was organized by Congress, the Ohio line remained as defined in the Ordinance of 1787 and in the Enabling Act for Ohio.

The merits of the subsequent controversy between Ohio and Michigan should now be clear. The Ohioans claimed the boundary which it had been the intent and purpose of Congress to give them in the light of the geographical knowledge of the times. The Michigan officials

¹⁵Senate Doc. 211, 1st Sess., 24th Cong., p. 13. Cf. p. 47.

¹⁶Jacob Burnet in his *Notes on the Early Settlement of the North Western Territory* (Cincinnati, 1847), p. 360, says: "It is generally known, to those who have consulted the maps of the western country extant at the time the Ordinance of 1787 was passed, that Lake Michigan was represented as being very far north of the position, which it has since been ascertained to occupy. On a map in the Department of State, which was before the committee of Congress, who formed the Ordinance, for the government of the Territory, the southern boundary of that Lake was laid down as being near the forty-second degree of north latitude; and there was a pencil line passing through the southern bend of the lake to the Canada line, which intersected the strait, between the river Raisin and the town of Detroit. That line was manifestly intended by the committee, and by Congress, to be the northern boundary of this State * * *". The map here described was in all probability Mitchell's map.

¹⁷Congress admitted Ohio without assent to or rejection of the proviso.

for the most part ignored this aspect of the question and insisted that the boundary defined by Congress should be established in accordance with the latest and most accurate surveys; in other words, that Maumee Bay and Toledo should properly be considered a part of Michigan instead of Ohio. The dispute was one phase of the eternal conflict between what law-makers actually said and what they intended to say.

The original question was magnified and complicated by certain considerations of national politics and by the pressure of commercial interests in both Ohio and Michigan.¹⁸ By 1836 the situation had developed to a stage where it was no longer susceptible of adjustment on the basis of the merits of the question alone. The report of the Senate Committee on the Judiciary in that year did indeed cite eleven maps of the earlier period in order to prove that the Ohio contention was correct; and the supporters of Michigan failed to produce any maps that belied this evidence.¹⁹ But, in view of the bitter feeling that had been engendered, and the imminence of an internecine border warfare, the controversy was ripe for a definitive settlement by congressional action on the ground of large public policy. Whatever may have been the immediate motives of Congress, it was an eminently wise compromise by which Ohio received the boundary she had claimed and the feelings of Michigan Territory were soothed with the gift of statehood and the annexation of a large portion of the Upper Peninsula in which such rich mineral deposits have since been developed.

¹⁸Mr. G. J. Miller emphasizes the economic and business considerations in his article, "The Establishment of Michigan's Boundaries," *Bulletin Am. Geog. Soc.*, vol. 43, pp. 339-351.

¹⁹*Senate Doc. 211, 1st Sess., 24th Cong.*, pp. 13-15, 32. Seven of these maps have been located in the Division of Maps and Charts in the Library of Congress, and photostat copies in the exact size of the originals have been deposited with the Ohio State Archaeological and Historical Society of Columbus and the Michigan Historical Commission. They bear out the contention of the committee. Of the remaining four, a map of the United States by Lewis was located of the date 1819 instead of 1815 and it proved the point for which the Senate Committee contended; the map called "an ancient map of the Northwestern Territory, with a supplement to the map of Hudson's and Baffin's bays" was not described in sufficient detail to afford identification; "Vame's [Vance's?] map of the United States, published in 1818" could not be found; and the map of Ohio by Hough and Bourne (not "Bounce"), published in 1815, proved to be a detailed map of the state which had no proper bearing upon the question in point inasmuch as Lake Michigan was not shown and the boundary, drawn by partisans of the Ohio claim, bore the legend, "The Northern boundary line of this State has not been precisely ascertained."

**BIBLIOGRAPHY OF THE OHIO-MICHIGAN BOUNDARY
DISPUTE.**

BIBLIOGRAPHY OF THE OHIO-MICHIGAN BOUNDARY DISPUTE

COMPILED BY ARTHUR MEIR SCHLESINGER

SOURCES MATERIAL.

Federal documents: The most extensive official sources are the *Executive Documents* and the *Senate Documents* for the twenty-third and the twenty-fourth Congresses. These volumes contain the correspondence between the two governors and the United States government, legislative reports, and almost all the important papers appertaining to the controversy. In connection therewith the *Journal of the House of Representatives*, the *Journal of the Senate*, the *Annals of Congress*, *Congressional Debates*, *Congressional Globe*, and the *United States Statutes at Large* are important at the appropriate periods. Miss Soule's footnotes give detailed references to these sources.

State and Territorial Documents: For the Michigan side, the most important sources are the *Journal of the Michigan Legislative Council, 1824-1834*, *Laws of the Territory of Michigan*, *Journal of the Proceedings of the Convention to form a Constitution for the State of Michigan*, and the *Senate and House Journals*. A large number of *Territorial Records* have been printed in the *Michigan Pioneer and Historical Society, Historical Collections*, vol. 36, pp. 100-620; vol. 37, pp. 17-31, 207-419. A collection of pamphlets, classified as *Early Michigan History*, may be consulted at the Michigan State Library. For Ohio, the *Acts of the General Assembly* and the *Journals*, particularly the *Journal of the extra session of the Assembly in June, 1835*, are important. In the State House at Columbus may be found the unpublished *Executive Documents* of the state, containing a large portion of the extensive correspondence of Governor Lucas in regard to the boundary. The constitutions of Michigan and Ohio are printed in Thorpe, F. N., *The Federal and State Constitutions, Colonial Charters, and other Organic Laws of the United States*, Washington, 1909.

Unofficial sources: The chief source is quasi-official in character, being the "Letters of Lucius Lyon," who as Senator-elect went to Washington to labor for the admission of Michigan. These have been published in the *Michigan Pioneer and Historical Society, Historical Collections*, vol. 27, pp. 412-604. Of interest is the article entitled "How They Fought, Personal Recollections of the Contest with Ohio Fifty Years Ago," in the *Michigan Pioneer Society Collections*, vol. 7, pp. 69-73. Insight into the politics and opinion of the day is afforded by the contemporary issues of the *Ohio State Journal*, *Niles' Register*, *Detroit Journal*, and *Detroit Free Press*.

Maps: Practically all the maps bearing on the boundary dispute may be found in the Library of Congress. Phillips, P. L., *A List of Maps of America in the Library of Congress* (Washington, 1901), should be consulted. Photostat copies of some of the more important maps, in the exact size of the originals may be found at the Ohio State Archaeological and Historical Society, Columbus, Ohio, and in the Archives of the Michigan Historical Commission.

SECONDARY MATERIAL.

The boundary dispute has yielded a wide literature of varying merit. Miss Soule's monograph stands forth as the most scholarly treatment of the episode. The subject has also been treated in the histories of the two states and of the Northwest Territory. The following list represents the principal articles and books treating of the boundary dispute.

Brown, J. W., "Account of the Boundary Dispute with Ohio," *Mich. Pion. and Hist. Soc., Hist. Colls.*, vol. 12, pp. 411-414.

Brown, J. W., and McNair, W., "The Battle of Phillips Corners," *Mich. Pion. and Hist. Soc., Hist. Colls.*, vol. 12, pp. 409-411.

Buell, Walter, "Michigan's Boundary Troubles," *Magazine of Western History*, vol. 3, pp. 457-570.

Burnet, Jacob, *Notes on the Early Settlement of the Northwestern Territory*. Cincinnati, 1847.

Campbell, J. V., *Outlines of the Political History of Michigan*. Detroit, 1876.

Chase, S. P., *A Sketch of the History of Ohio*. Cincinnati, 1833.

Galloway, Tod B., "The Ohio-Michigan Boundary Line Dispute," *Ohio Arch. and Hist. Soc. Pubs.*, vol. 4, pp. 199-230.

Hinsdale, B. A., *The Old Northwest*. New York, 1891.

Knapp, H. S., *History of the Maumee Valley*. Toledo, 1877.

Larzelere, C. S., "The Boundaries of Michigan," *Mich. Pion. and Hist. Soc., Hist. Colls.*, vol. 30, pp. 1-27.

Mendenhall, T. C., and Graham, A. A., "Boundary Line between Ohio and Indiana, and between Ohio and Michigan," *Ohio Arch. and Hist. Soc. Pubs.*, vol. 4, pp. 127-198.

Miller, G. J., "The Establishment of Michigan's Boundaries: A Study in Historical Geography," *Am. Geograph. Soc. Bulletin*, vol. 43, pp. 339-351.

Parish, J. C., *Robert Lucas*. (*Iowa Biographical Series*, B. F. Shambaugh, ed.). Iowa City, 1907.

Robson, F. E., "The Michigan and Ohio Boundary Line," *Mich. Pion. and Hist. Soc., Hist. Colls.*, vol. 11, pp. 216-227.

Schlesinger, A. M., "Basis of the Ohio-Michigan Boundary Dispute," the present volume.

Soule, A. M., "The Southern and Western Boundaries of Michigan," *Mich. Pion. and Hist. Soc., Hist. Colls.*, vol. 27, pp. 346-390; also *Mich. Pol. Sci. Assn. Pubs.*, vol. 2, pp. 29-81.

Stuart, L. G., "Verdict for Michigan. How the Upper Peninsula became a part of Michigan," *Mich. Pion. and Hist. Soc., Hist. Colls.*, vol. 27, pp. 390-403.

Waggoner, Clark, *History of the City of Toledo and Lucas County*. New York, 1888.

Way, W. V., *The Facts and Historical Events of the Toledo War of 1835*. Toledo, 1869.

APPENDIX I.

Below are listed the libraries, scientific and educational institutions to which the reports of the survey are delivered in the order in which they are issued. Those from which publications are received in exchange are indicated on the list by an asterisk.

MICHIGAN PUBLIC LIBRARIES, SCIENTIFIC AND EDUCATIONAL INSTITUTIONS.

Name.	Address.
Adrian College.....	Adrian, Michigan.
Albion College.....	Albion, Michigan.
Alma College.....	Alma, Michigan.
*University of Michigan Library.....	Ann Arbor, Michigan.
Benton Harbor College.....	Benton Harbor, Michigan.
Benzonia Academy.....	Benzonia, Michigan.
Ferris Institute.....	Big Rapids, Michigan.
Detroit College.....	Detroit, Michigan.
Detroit University School.....	Detroit, Michigan.
*Michigan Agricultural College.....	East Lansing, Michigan.
Hillsdale College.....	Hillsdale, Michigan.
Hope College.....	Holland, Michigan.
*College of Mines.....	Houghton, Michigan.
Western State Normal College.....	Kalamazoo, Michigan.
Northern State Normal College.....	Marquette, Michigan.
Central State Normal College.....	Mt. Pleasant, Michigan.
*Olivet College.....	Olivet, Michigan.
Cleary Business College.....	Ypsilanti, Michigan.
State Normal College.....	Ypsilanti, Michigan.
Ypsilanti Public Library.....	Ypsilanti, Michigan.
Adrian Public Library.....	Adrian, Michigan.
Albion Public Library.....	Albion, Michigan.
Township Library.....	Allegan, Michigan.
Public Library.....	Alpena, Michigan.
Ann Arbor Public Library.....	Ann Arbor, Michigan.
Armada Free Public Library.....	Armada, Michigan.
Battle Creek Public School Library.....	Battle Creek, Michigan.
Bay City Public Library.....	Bay City, Michigan.
The Phelps Free Library.....	Big Rapids, Michigan.
City Library.....	Benton Harbor, Michigan.
Bessemer Public Library.....	Bessemer, Michigan.
Cadillac Public Library.....	Cadillac, Michigan.
Calumet and Hecla Company Library.....	Calumet, Michigan.
Free Public Library.....	Charlotte, Michigan.
McMillan High School Library.....	Detroit, Michigan.
Eastern High School.....	Detroit, Michigan.
Public Library.....	Detroit, Michigan.
A. J. Phillips Library.....	Fenton, Michigan.
Public School Library.....	Frankfort, Michigan.
Grand Haven Public Library.....	Grand Haven, Michigan.
Grand Ledge Public Library.....	Grand Ledge, Michigan.
Grand Rapids Public Library.....	Grand Rapids, Michigan.
Central High School Library.....	Grand Rapids, Michigan.
Kent Scientific Museum.....	Grand Rapids, Michigan.
Public School Library.....	Hancock, Michigan.

Name.	Address.
Harbor Springs Public Library.....	Harbor Springs, Michigan.
Houghton Public Library.....	Houghton, Michigan.
Keweenaw Historical Society Library.....	Houghton, Michigan.
Howell Carnegie Library.....	Howell, Michigan.
Hudson Public Library.....	Hudson, Michigan.
Carnegie Library.....	Iron Mountain, Michigan.
Baxter Laundry Library.....	Grand Rapids, Michigan.
Carnegie Library.....	Ironwood, Michigan.
Jackson Public Library.....	Jackson, Michigan.
Ladies Library.....	Jonesville, Michigan.
Public Library.....	Kalamazoo, Michigan.
Kalamazoo College Library.....	Kalamazoo, Michigan.
*Lansing Public Library.....	Lansing, Michigan.
Ludington Public Library.....	Ludington, Michigan.
Marine City Public School Library.....	Marine City, Michigan.
Peter White Public Library.....	Marquette, Michigan.
Mendon Free Public Library.....	Mendon, Michigan.
Mt. Pleasant Public Library.....	Mt. Pleasant, Michigan.
Spies Public Library.....	Menominee, Michigan.
Hackley Public Library.....	Muskegon, Michigan.
Public Library.....	Niles, Michigan.
Ladies Library.....	Northville, Michigan.
Otsego Public School Library.....	Otsego, Michigan.
Township Library.....	Otsego, Michigan.
Public Library.....	Petoskey, Michigan.
Port Huron Public Library.....	Port Huron, Michigan.
Quincy Free Public Library.....	Quincy, Michigan.
Romeo Public Library.....	Romeo, Michigan.
Dunbar School of Agriculture.....	Sault Ste. Marie, Michigan.
Hoyt Library.....	Saginaw, Michigan.
Saginaw (E. S.) Public School Library.....	Saginaw, Michigan.
Saranac Public School Library.....	Saranac, Michigan.
Traverse City Public Library.....	Traverse City, Michigan.
Tecumseh Public Library.....	Tecumseh, Michigan.
Three Rivers Free Library.....	Three Rivers, Michigan.
Township Library.....	Union City, Michigan.
Schoolcraft Township Library.....	Vicksburg, Michigan.
*State Highway Department.....	Lansing, Michigan.
Escanaba Public Library.....	Escanaba, Michigan.
Mt. Clemens Public Library.....	Mt. Clemens, Michigan.
Negaunee Public Library.....	Negaunee, Michigan.
New Baltimore Public School Library.....	New Baltimore, Michigan.
Portland Public Library.....	Portland, Michigan.
Quimby Public School Library.....	Quimby, Michigan.
Northport Public School.....	Northport.
Edwardsburg Public School.....	Edwardsburg.
Board of State Tax Commissioners.....	Lansing.
Western Michigan Development Bureau.....	Traverse City.

FOREIGN COLLEGES, LIBRARIES, SCIENTIFIC AND EDUCATIONAL INSTITUTIONS.

Name.	Address.
University of Arizona Library.....	Tucson, Arizona.
McGill University Library.....	Montreal, Canada.
Manitoba University Library.....	Winnipeg, Canada.
*Colorado School of Mines Library.....	Golden, Colorado.
Department of Geology, Trinity College.....	Hartford, Connecticut.
Sheffield Scientific School, Dept. of Geology.....	New Haven, Connecticut.
*University of Chicago.....	Chicago, Illinois.
*Field Museum of Natural History.....	Chicago, Illinois.

Name.	Address.
John Crerar Library	Chicago, Illinois.
*University of Illinois Library	Urbana, Illinois.
*Purdue University Library	LaFayette, Indiana.
Howard Memorial Library	New Orleans, Louisiana.
Amherst College Library	Amherst, Massachusetts.
Mass. Institute of Technology	Boston, Massachusetts.
Williams College Library	Williamston, Massachusetts.
University of Minn., Winchell Library of Geology	Minneapolis, Minnesota.
*Minnesota Historical Society	St. Paul, Minnesota.
University of Missouri Library	Columbia, Missouri.
*University of Missouri. (School of Mines and Metallurgy)	Rolla, Missouri.
St. Louis Public Library	St. Louis, Missouri.
Rutgers College Library	New Brunswick, New Jersey.
Princeton University Library	Princeton, New Jersey.
Grosvenor Public Library	Buffalo, New York.
Cornell University Library	Ithaca, New York.
American Society of Civil Engineers	New York City, New York.
American Geographical Society of N. Y.	New York City, New York.
*American Museum of Natural History	New York City, New York.
New York Public Library	New York City, New York.
New York University, Dept. of Geology	New York City, New York.
Public Library of Cincinnati	Cincinnati, Ohio.
Adelbert College Library	Cleveland, Ohio.
Cleveland Public Library	Cleveland, Ohio.
Ohio State University Library	Columbus, Ohio.
Oberlin College Library	Oberlin, Ohio.
*State University of Oklahoma, Dept. of Geology	Norman, Oklahoma.
Muhlenberg College	Allentown, Pennsylvania.
Bryn Mawr College Library	Bryn Mawr, Pennsylvania.
Pennsylvania State Museum	Harrisburg, Pennsylvania.
Academy of Natural Science	Philadelphia, Pennsylvania.
American Philosophical Society	Philadelphia, Pennsylvania.
University of Pennsylvania	Philadelphia, Pennsylvania.
Free Library of Philadelphia	Philadelphia, Pennsylvania.
*Carnegie Library	Pittsburg, Pennsylvania.
Lehigh University, Dept. of Geology	South Bethlehem, Pennsylvania.
Fisk University, Geological Library	Nashville, Tennessee.
Seattle Public Library	Seattle, Washington.
Milwaukee Public Library	Milwaukee, Wisconsin.
Milwaukee Public Museum	Milwaukee, Wisconsin.
*Chicago Academy of Science	Chicago, Illinois.
*Davenport Academy of Science	Davenport, Iowa.
*Colorado College	Colorado Springs, Colorado.
*Kansas Academy of Science	Topeka, Kansas.
*Portland Society of Natural History	Portland, Maine.
Boston Society of Natural History	Boston, Massachusetts.
*Geological Museum	Cambridge, Massachusetts.
*University of Minnesota	Minneapolis, Minnesota.
Academy of Science	St. Louis, Missouri.
*Missouri Botanical Garden	St. Louis, Missouri.
*State Engineer and Surveyor	Albany, New York.
American Institute of Mining Engineers	New York City, New York.
*State Bureau of Mines	Corvallis, Oregon.
Wyoming Hist. and Geological Society	Wilkes-Barre, Pennsylvania.
American Mining Congress	Washington, D. C.
*Bureau of Mines	Washington, D. C.
*Department of Agriculture	Washington, D. C.
*Director of the Census	Washington, D. C.
Hygienic Laboratory	Washington, D. C.
*Library of Congress	Washington, D. C.

Name.	Address.
*Office of Public Roads, U. S. Department of Agriculture.....	Washington, D. C.
Smithsonian Institution.....	Washington, D. C.
*United States Geological Survey.....	Washington, D. C.
*University of Wisconsin.....	Madison, Wisconsin.
Peabody Museum, Yale University.....	New Haven, Connecticut.
Northwestern University.....	Evanston, Illinois.
Louisiana State Library.....	Baton Rouge, Louisiana.
Smith College Library.....	Northampton, Massachusetts.
Washington University.....	St. Louis, Missouri.
Columbia University.....	New York City, New York.
State Normal College.....	Bowling Green, Ohio.
University of Oregon.....	Eugene, Oregon.
Commercial Museum.....	Philadelphia, Pennsylvania.
Lincoln Memorial University.....	Cumberland Gap, Tennessee.
University of Kansas.....	Lawrence, Kansas.
University of Tennessee.....	Knoxville, Tennessee.
University of Washington.....	Seattle, Washington.
*Australian Museum.....	Sydney, Australia.
Mines Department.....	Melbourne, Victoria, Australia.
*Queensland Museum.....	Brisbane, Australia.
*Abhandlungen Der. K. K. Geologischen Reichsanstalt.....	Wien (Vienna) Austria.
*Bureau of Mines.....	Toronto, Canada.
*Department of Mines.....	Ottawa, Canada.
*Geological Survey Library.....	Ottawa, Canada.
Liverpool Geological Society.....	Liverpool, England.
Geological Survey of England and Wales.....	London, England.
Patent Office Library.....	London, W. C., England.
*Mysore Geological Survey.....	Mysore, India.
*Tahaku Imperial University.....	Sendai, Japan.
*Imperial Geological Survey.....	Tokyo, Japan.
*Instituto Geologico de Mexico.....	Mexico City, Mexico.
*New Zealand Geological Survey.....	Wellington, New Zealand.
Da Escola de Minas de Ouro Preto.....	Ouro Preto, Brazil, S. A.
Instituto de Geologia Y Perforaciones.....	Montevideo, Uruguay, S. A.
University of Upsala.....	Upsala, Sweden.
*Geological Survey of W. A.....	Perth, Western Australia.
Dulau & Co.....	London, England.

STATE GEOLOGICAL SURVEYS.

Name.	Address.
*Geological Survey.....	University, Alabama.
Geological Survey.....	Tucson, Arizona.
*Geological Survey.....	Fayetteville, Arkansas.
*State Mineralogist.....	San Francisco, California.
*Geological Survey.....	Boulder, Colorado.
*Geological Survey.....	Middletown, Connecticut.
*Geological Survey.....	Tallahassee, Florida.
*Geological Survey.....	Atlanta, Georgia.
*Geological Survey.....	Urbana, Illinois.
*Geological Survey.....	Indianapolis, Indiana.
*Geological Survey.....	Iowa City, Iowa.
*Geological Survey.....	Lawrence, Kansas.
*Geological Survey.....	Lexington, Kentucky.
*Geological Survey.....	Baton Rouge, Louisiana.
State Survey Commission.....	Augusta, Maine.
*Geological Survey.....	Baltimore, Maryland.

Name.	Address.
*Geological Survey.....	Jackson, Mississippi.
*Geological Survey.....	Rolla, Missouri.
*Geological Survey.....	Lincoln, Nebraska.
*Geological Survey.....	Trenton, New Jersey.
*Geological Survey.....	Albany, New York.
*Geological Survey.....	Chapel Hill, North Carolina.
*Geological Survey.....	Grand Forks, North Dakota.
*Geological Survey.....	Columbus, Ohio.
*Geological Survey.....	Norman, Oklahoma.
*Topographic and Geologic Survey Com.....	Beaver, Pennsylvania.
*Geological Survey.....	Charleston, South Carolina.
*Geological Survey.....	Vermilion, South Dakota.
*Geological Survey.....	Nashville, Tennessee.
Bureau of Economic Geology and Technology...	Austin, Texas.
*Geological Survey.....	Burlington, Vermont.
*Geological Survey.....	Charlottesville, Virginia.
*Geological Survey.....	Seattle, Washington.
*Geological Survey.....	Morgantown, West Virginia.
*Geological Survey.....	Madison, Wisconsin.
*Geological Survey.....	Cheyenne, Wyoming.

APPENDIX II.

Catalog and Table of Contents of the Publications of the Michigan Geological and Biological Survey¹.

DOUGLASS HOUGHTON, State Geologist.

Reports from 1838-1846 were published with Legislative documents as follows: S. D. means Senate Document; H. D., House Document; J. D., Joint Document. State Geologist is abbreviated S. G., and State Geological Survey, S. G. S.

- *1838. Report of a select committee of the Board of Regents of the University on the collection of the S. G.
H. D. Vol. I, p. 1-2; S. D. No. 1, p. 1. H. D. No. 55 is duplicate of No. 1. Statement of the expenditures on account of the S. G. S. for the year 1837.
H. D. No. 8, pp. 115-118; S. D. No. 21. (First annual account of the S. G.), pp. 315-318.
Report of the S. G. (first annual).
H. D. No. 24, pp. 276-317, separately, No. 14, pp. 1-39.
Communication from the S. G.
H. D. No. 46, pp. 457-460.
- *1839. Report of the S. G., in relation to the improvement of State Salt Springs.
H. D. No. 2, pp. 39-45; S. D. No. 1, pp. 1-7.
Report of the committee on the S. G.'s report in relation to the improvement of the State Salt Springs.
H. D. No. 4, p. 123.
Report of the S. G. in relation to the iron ore, etc., on the school section in town five south, range seven west, in Branch county.
H. D. No. 21, pp. 342-344.
Second annual report of the State Geologist.
H. D. No. 23, pp. 380-507; S. D. No. 12, pp. 264-391.
Report of the Committee of the Senate on Manufacturers, to whom was referred the communication of the S. G. relative to salt springs and the salines of the State.
S. D. No. 3, pp. 85-86 (parallel to H. D. No. 4).
Communication from the S. G. relative to the S. G. S.
S. D. No. 25, pp. 463-466.
- *1840. Report of S. G. relative to the improvement of the salt springs.
H. D. No. 2, Vol. I, pp. 18-23; S. D. No. 8, Vol. II, pp. 153-158.
Annual report of the State Geologist (third, map of Wayne county).
H. D. No. 27, Vol. II, pp. 206-293; S. D. No. 7, Vol. II, pp. 66-153, separately No. 8, pp. 1-120.
Report of the select committee to whom was referred the several reports of the S. G.
H. D. No. 46, Vol. II, pp. 455-461.
Report of the majority of the Committee on Finance on the communication and accounts of the S. G. for 1839.
Report of the minority of the Committee on Finance on the same subject.
Report of the select committee on S. G.'s report and accounts relative to improvement of Salt Springs, etc.
S. G.'s account for the year 1839, the same being the subject matter of the three preceding reports.
S. D. Nos. 15, 16, 17, 18, pp. 209-224.
- *1841. Special message concerning State Salt Springs.
H., S. and J. D. No. 5, pp. 235-254.
Annual report of the S. G. (fourth).
H., S. and J. D. No. 11, pp. 472-607, separately H. D. No. 27, pp. 1-184.
Report of the S. G. relative to county state maps.
H. D. No. 35, pp. 94-98.

¹NOTE.—The greater part of the publications of the Michigan Geological and Biological Survey are distributed gratis to public libraries and exchanges, and also to citizens of Michigan on the payment of forwarding charges. A considerable number of copies of each publication are reserved for sale at the list price.

*Publication out of print.

- *1842. Report of the S. G. relative to the State Salt Springs.
H. D. No. 2, pp. 15-21; S. D. No. 1, pp. 1-9.
Report of the select committee in relation to the report of the S. G.
H. D. No. 19, pp. 77-79.
Annual report of the S. G. (fifth).
J. D. No. 9, pp. 436-441.
- *1843. Annual Report of S. G. (sixth).
J. D. No. 8, pp. 398-402.
Report of the S. G. relative to the State Salt Springs.
S. D. No. 9, pp. 402-408.
- *1844. Annual report of the S. G. (seventh).
S. D. No. 11 (three pages).
D. Houghton undertook an arrangement with the Linear Survey of the U. S. Land Office by which a certain amount of geological work was done, which was never published by the State, the results of which appear largely in the township plats of the Land Office, and in the report of C. T. Jackson, 1849, U. S. S. Ex. D. No. 1, pp. 371-935, H. Ex. D. No. 5, Vol. 3, Part 3, including sub-reports of W. A. Burt and Bela Hubbard on the geology of the sub-divisions of the Linear Survey. First Session 31st Congress, and of Foster & Whitney, U. S. Geologists, Part I, H. Ex. D. No. 69, pp. 1-224 and 12 Plates, First Session 31st Congress; S. Ex. D. No. 2, Vol. 2, p. 147, Second Session 31st Congress; Part II, S. Ex. D. No. 4, Vol. 3, p. 3, Special Session 32d Congress.
The work of the Geological Survey was interrupted by the death of D. Houghton while actively engaged in explorations.
- *1846. Report from Geological Department by S. W. Higgins, principal assistant.
J. D. No. 12, 22 pp.
Report of the joint committee relative to the Geological Survey.
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A. WINCHELL, State Geologist.

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Part II. Annotated Lists

(a) Notes on the Vegetation of Isle Royale, by W. P. Holt; (b) Annotated List of Certain Invertebrates, by Dr. C. C. Adams; (c) Annotated List of the Mollusca by Bryant Walker; (d) Report on the Orthoptera of the 1905 Expedition to Isle Royale by A. P. Morse; (e) Neuropteroid Insects from Isle Royale, by Dr. J. G. Needham; (f) Diptera of the 1905 University Museum Expedition to Isle Royale, by Prof. J. S. Hine; (g) Annotated List of Isle Royale Hymenoptera by E. S. Titus; (h) The Ants, by Dr. Wm. M. Wheeler; (i) The Cold Blooded Vertebrates, by Dr. A. G. Ruthven; (j) Annotated List of the Birds, by Max M. Peet; (k) Notes on Isle Royale Mammals and their Ecological Relations, by Dr. C. C. Adams.

R. C. ALLEN, State Geologist.

NOTE: THE PUBLICATION OF THE ANNUAL REPORT, AS SUCH, UNDER A SINGLE COVER, WAS DISCONTINUED WITH THAT FOR THE YEAR 1908, AND ALL SUBSEQUENT REPORTS ARE ISSUED IN THE FORM OF PUBLICATIONS.

Publication 1, Biological Series 1. 1909.

Biological Survey of Michigan. 95 pp. 17 Pls. Bound in paper, cloth backs.

(a) The Crawfishes of Michigan, by A. S. Pearse, 8 Pls.; 1. Habits and life history; 2. Economic importance; 3. Classification; 4. Key to Michigan species; 5. Description of species and habits.

(b) The Insect Galls of Michigan, by Mel T. Cook; 1. Classification; 2. Description of species.

(c) The Birds of School Girl's Glen, Ann Arbor, Michigan: A study in local ornithology by A. D. Tinker. (9 Pls.) 1. Topography of the region; 2. Distribution of species in relation to environment; 3. Seasonal list of species; 4. Annotated list.

(d) Preliminary list of the sites of aboriginal remains, by H. I. Smith, American Museum of Natural History, New York.25 .05

Publication 2, Geological Series 1. 1910.

The Monroe Formation of Southern Michigan and Adjoining Regions by Professors A. W. Grabau and W. H. Sherzer. 248 pp., 32 Pls., 9 Figs.

(a) Geological history and distribution; (b) Stratigraphy, structure, and local distribution; (c) The Sylvania sandstone, its distribution, nature, origin, economic importance, etc.; (d) Description of Monroe fossils with 24 plates; (e) Stratigraphic and palaeontologic summary; (f) Correlation of the Monroe formation of Michigan, Ohio, and Canada with the Upper Silurian of eastern North America and elsewhere; and (g) Palaeogeography of Monroe time.50 .15

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The Iron River Iron Bearing District of Michigan by R. C. Allen. 150 pp., 16 Pls., 18 Figs., 1 geologic and topographic map. Bound in paper, cloth backs.

(a) History and development; table of iron ore shipments, 1882-1909; (b) Physiography; Topographic features, glacial and glacio-fluvial

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deposits, soils, drainage, etc.; (c) General geology: 1. Kewatin—Brule volcanics; 2. Lower Huronian—the Saunders formation, its distribution, character, structure, thickness and relation to adjacent formations; (d) Upper Huronian—the Michigamme slate series: 1. Distribution, character and structure, 2. The Vulcan formation, its distribution, character, structure, ore bodies, and the mines, 3. The slates and graywackes, 4. Basic intrusives and extrusives, 5. Relations of the Upper Huronian to the Saunders (Lower Huronian) formation; (e) The Ordovician—the Sheridan formation; (f) Conditions of deposition of the Michigamme series: 1. Sources of sediments, 2. Origin of iron formation, 3. The iron ores—their character and composition; (g) The iron ore deposits—their form, structure, depth, relation to wall rocks, etc.; (h) Concentration of the ores, (i) Exploration.

*Publication 4, Biological Series 2. 1911.

A Biological Survey of the Sand Dune Region on the South Shore of Saginaw Bay, Michigan.

(a) Description of the environmental conditions and a discussion of the geographic relations of the Biota, by A. G. Ruthven; (b) Ecological Relations of the Flora, by G. H. Coons; (c) Catalogue of Plants; (d) Mollusca, by H. B. Baker; (e) Thysanoptera and Orthoptera, by A. F. Shull; (f) Mallophaga, by C. A. Shull and M. A. Carriker, Jr.; (g) Fish by A. L. Leathers; (h) Amphibians and Reptiles, by A. G. Ruthven; (i) Birds, by N. A. Wood and Fred Gaige; (j) Mammals, by N. A. Wood.

Publication 5, Geological Series 3. 1911.

Part I. The Late Glacial and Post Glacial Uplift of the Michigan Basin, and Earthquakes in Michigan, by Prof. W. H. Hobbs, 96 pp. 4 Pls. 53 Figs. Bound in paper, cloth backs.

(a) Late uplift and tilting of northern counties; (b) Evidences of uplift: Shore lines, wave cut terraces and notched cliffs, stacks, sea arches, etc.; (c) History of the successive glacial lakes; (d) Gilbert's prophecy of future reversal of the St. Lawrence drainage to the earlier Chicago outlet; (e) Warping of the ancient beaches; (f) Hinge lines; (g) Study of ancient beaches about northern end of Green Bay; (h) Conclusions regarding manner of uplift.

Part II. Earthquakes.

(a) Early history; (b) Newspaper and telegraph period; (c) The earthquakes; (d) Earthquakes connected with the mines of the Northern Peninsula.

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Publication 6, Geological Series 4, 1912.

The Keweenaw Series of Michigan, by Dr. A. C. Lane. 2 Vols. 983 pp. 15 Pls. (Maps included), Pls. VIII-XV in pocket, 69 Figs.

Volume I.

(a) Popular description of major geological structures of Lake Superior Basin, the stratigraphy, etc.: 1. The Keweenaw fault and other faults, 2. The general character and succession of the beds, 3. Sources of copper, 4. Agents of metamorphism, 5. Resultant minerals, 6. Shear zones and shoots, 7. Surface geology, 8. Distribution of float copper; (b) Nomenclature and chemical relations of the Keweenaw rocks; (c) Microscopic petrography—the minerals and textures; (d) The grain of igneous rocks; (e) Detailed stratigraphy as shown by the mines and outcrops.

Volume II.

(f) Temperature of the copper mines; (g) Mine waters; (h) Copper formation; (i) Comparison with similar deposits; (j) The development of the copper mines and their geological relations, by A. H. Meuche; (k) Appendix: Recent developments, geological questions, and bibliography.

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*Publication 7, Geological Series 5. 1912.

Surface Geology of the Northern Peninsula of Michigan, with notes on agricultural conditions and water power, by Frank Leverett, 91 pp. 8 Pls. 7 Figs. (Plate I is a large scale surface geology or soil map). Bound in paper, cloth backs.

(a) Physiography, (b) Glacial or surface features,—moraines, outwash aprons, drumlins, eskers, kames, glaciated rock surfaces, etc.; (c) Lake history,—old shore lines and beaches; (d) Lakes Ontonagon, Duluth, Algonquin, Nipissing and their deposits; (e) Climatic conditions,—temperature and precipitation; (f) Notes on agricultural conditions and soil classes by townships; (g) Water power; (h) Water supply.

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*Publication 8, Geological Series 6. 1911.

Mineral Resources of Michigan with statistical tables of production and value of mineral products for 1910, 1911, and prior years. 465 pp. 21 Pls. 19 Figs. (Maps included.)

(a) The Copper Industry of Michigan, by R. E. Hore, 116 pp. 12 Pls., 4 Figs.: 1. Location of mines, general geology of Keweenaw Point, structure and lithology of the copper bearing rocks, 2. Mode of occurrence of the copper, 3. Ore deposits or lodes, 4. Character and value of the ore, 5. Methods of prospecting and development, 6. Methods of mining, 7. Crushing and concentration, 8. Smelting, 9. Costs and profits, 10. Present condition of industry, 11. Mining companies, 12. Statistical tables—production, costs and profits.

(b) The Iron Mining Industry of Michigan, by R. C. Allen, 103 pp., 7 Figs. (including maps): 1. Introduction—Importance and permanency of industry, the iron formation and character of the ores, 2. Important features of iron mining industry—exploration, royalties, values, ownerships and reserves, prices and price determinations, transportation, ore sampling and analyses, 3. Recent developments; Menominee range—Menominee district, Calumet trough, Metropolitan trough, Crystal Falls district, Iron River district; Gogebic range; Marquette range and Gwinn district, 4. Statistical tables—shipments (1855-1911) by districts, cargo analyses, prices, freight rates and mine values, list of mines with location, ownership, sales agents, etc.

(c) Pig Iron Industry in Michigan, by Prof. A. E. White, 35 pp., 3 Pls.: 1. Introduction—production, history and development of the industry, 2. Details regarding blast furnaces of Michigan: Charcoal furnaces; Coke furnaces, 3. The J. T. Jones' Step Process for the metallization of low grade iron ores.

(d) Michigan Coal, by R. A. Smith, 44 pp., 2 Figs. 1. The Michigan coal basin: Its position and extent, thickness of coal formation, occurrence of the coal and coal horizons, variation in Michigan coal measures, areas favorable for coal occurrence, 2. Tests and analyses: heating power and boiler tests, analyses, summary, 3. Erosion and disturbance of coal: Drift filled channels, sandstone channels, faults or displacements; 4. Development of coal: principles to guide exploration, methods of exploration and development, 5. Value of coal lands and coal rights, 6. Production, 7. Mining methods and the mines, 8. Statistical tables—production, distribution, value, etc.

(e) Gypsum and Gypsum Products, by R. A. Smith, 9 pp. 1. Fig. 1. Composition of gypsum, 2. Varieties, 3. Occurrence and distribution, 4. Geological horizons, 5. Origin, 6. Manufacture of calcined gypsum, 7. Gypsum products, 8. Production, 9. Statistical and graphic tables of production.

(f) The Salt Industry, by C. W. Cook, 21 pp., 4 Pls., 2 Figs. 1. Historical: Development of Saginaw Valley; of Lake Michigan area; along Detroit and St. Clair Rivers, 2. Evaporating methods, 3. Inspection and grading, 4. List of companies, 5. Statistical tables of production.

(g) Michigan Cement, 17 pp., 2. Pls. 1. Historical, 2. Classification of cements, 3. Raw materials: Sources of lime, silica, and alumina, 4. List of companies, 5. Statistical tables, 6. Present outlook, 7. Bibliography.

(h) Gold in Michigan, by R. C. Allen: 1. Discovery in Michigan, 2. The Ropes and other mines, 3. Mining companies, 4. Placer gold.

(i) Oil and gas in Michigan, by R. A. Smith: 1. Exploration, 2. Anticlinals, 3. Oil fields and districts: Port Huron field; Southeastern district; Southwestern district; Western district; Central part of state: Northern part of Southern Peninsula; Northern Peninsula, 4. Tables of deep borings showing the several horizons, their depth, thickness, etc.

(j) Directory of the mineral producers of Michigan.

(k) Miscellaneous statistical tables—pottery, mineral waters, clay, sandstone, lime, limestone, sand and gravel, sand-lime brick, brick and tile, summary of mineral products.

(l) Appendix—Production and value of mineral products of Michigan for 1911.

*Publication 9, Geological Series 7. 1910.

Surface Geology and Agricultural Conditions of the Southern Peninsula, by Frank Leverett. Chapter on Climate, by C. F. Schneider. 144 pp. 15 Pls. (3 maps), 16 Figs.

(a) Physiography: 1. General geologic features and geologic terms, 2. Altitude, 3. Drainage systems.

(b) Climatic conditions: 1. Seasonal and annual means, 2. Temperature, 3. Frosts, 4. Precipitation, 5. Drought, 6. Sunshine, 7. Winds, 8. Relative humidity, 9. General climatic data.

(c) Glacial features: 1. Features due to early stages of glaciation.

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2. Moraines and their outwash, 3. Features between moraines.
(d) Lake features and history: 1. Introductory statement, 2. Lake Chicago, 3. Lake Maumee, 4. First Lake Saginaw, 5. Lake Arkona, 6. Later Lake Saginaw, 7. Lake Whittlesey, 8. Lake Warren, 9. Lake Wayne, 10. Lake Elkton, 11. Beginnings of Lake Erie and Lake St. Clair, 12. Lake Algonquin, 13. Nipissing Great Lakes.
(e) Agricultural conditions: 1. General notes, 2. Conditions by counties (in tabulated form).

Publication 10, Biological Series 3. 1911.

The Herpetology of Michigan, by A. G. Ruthven, Crystal Thompson and Helen Thompson. 190 pp. 11 Pls. 55 Figs.

- (a) The Herpetology of Michigan; (b) General introduction; (c) The Amphibians by Crystal Thompson and Helen Thompson: 1. Literature, 2. Methods of study, collecting and preserving specimens, 3. Description of species, 4. Glossary; (d) The Reptiles, by A. G. Ruthven and Frances Dunbar: 1. Literature, 2. Methods of study, collecting and preserving specimens, 3. Description of species, 4. Glossary, 5. General bibliography; (e) Memoranda towards Bibliography of the Archaeology of Michigan, by Harlan I. Smith. \$0.80 \$0.10

Publication 11, Geological Series 8. 1911.

Geological Report on Arenac County, by W. M. Gregory. 145 pp. 7 Pls. 18 Figs.

- (a) Historical and geographical introduction; (b) Previous geological work; (c) Climate; (d) The geological column; (e) Geology of the Palaeozoic formations; (f) Pleistocene or glacial geology; (g) Water resources: Pt. I. Hydrology, Pt. II. Hydrography; (h) Altitudes or elevations; (i) The soil and soil products; (j) Economic resources and raw materials: sand and gravel, the sand soil products, the jack pine flora, clay, gypsum, limestone, coal, water resources, and the soils.50 .10

Publication 12, Geological Series 9. 1911.

Geological Report on Wayne County by W. H. Sherzer. 388 pp. 32 Pls. 22 Figs.

- (a) Geographical and historical introduction; (b) Glacial history of the Huron-Erie Basin: 1. Ice invasions, 2. Lake history; (c) Physiography of Wayne county: Moraines, till plains, glacial outwash plains, beaches, deltas, distributaries, lake deposits; (d) Drainage; (e) Soils and subsoils; (f) Climate; (g) Geological formations: 1. Coldwater shales, 2. Berea sandstone, 3. Antrim shale, 4. Traverse limestones and shales, 5. Dundee limestone, 6. Monroe formation, 7. Salina, 8. Niagara limestone, 9. Deeper lying formations; (h) Water resources: 1. Surface waters, 2. Waters from lake and river deposits, 3. From glacial deposits, 4. From bed rock, 5. Water decline in Lower Huron region; (j) Economic resources: 1. Materials for constructive purposes—clays, sand, gravel, limestone, dolomite, and sandlime brick, 2. Chemical materials for direct use or manufacture,—calcium carbonate, glass sand, mineral waters, rock salt, and pigments, 3. Abrasives, 4. Fuels,—peat, oil and gas; (k) Summaries by civil divisions: 1. Morainic areas, 2. Till plain areas, 3. Delta areas, 4. Beach and dune areas; (k) Preliminary report on the fauna of the Dundee limestone by A. W. Grabau: 1. Summary of faunas 2. Summary of Dundee-Columbus fauna, 3. Supplementary note. 1.00 .10

Publication 13, Geological Series 10. 1912.

Mineral Resources of Michigan with statistical tables of production and value of mineral products for 1912 and prior years. 255 pp. 8 Pls. 1 Fig.

- (a) Michigan copper industry in 1912, by R. E. Hore, Michigan College of Mines. 81 pp. 8 Pls. 1. General trade conditions,—dividends paid by companies, scarcity of labor, increased construction and development work, diamond drill exploration, employer's liability and workmen's compensation act. 2. The copper industry by companies. 3. Statistical tables.
(b) Potash. 1. Investigation by United States and Canadian Geological Surveys. 2. The salt deposits of Michigan. 3. Theories of deposition. 4. Possible occurrence of potash salts and potash brines. 5. Projected test wells for potash in Saginaw valley.
(c) Sand and gravel. 1. Production and value. 2. New directory. 3. Testing of sand and gravel for concrete material.
(d) Preliminary statement on limestone. 1. Previous report on limestone. 2. Present limestone reserves of the state. 3. Field work on the limestone deposits of the state in 1913.

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(e) Statistical tables for 1912 and prior years. 1. Iron ore. 2. Pig iron. 3. Portland cement. 4. Salt. 5. Brick and tile. 6. Coal. 7. Limestone. 8. Sand and gravel. 9. Gypsum. 10. Silver. 11. Sand-lime brick. 12. Pottery. 13. Mineral water. 14. Trap rock. 15. Sandstone. 16. Clay. 17. Natural gas. 18. Summary table of production and value of mineral products for 1912.

(f) Directory of mineral producers in Michigan for 1912. \$0.60 \$0.10

Publication 14, Geological Series 11. 1912.

The Occurrence of Oil and Gas in Michigan, by R. A. Smith, 281 pp., 3 Pls., 19 Figs.

(a) Letter of transmittal. 1. Warning against fraudulent schemes for exploration for oil and gas and against so-called "locators" and "oil smellers." 2. "Community projects." 3. Encouragement of legitimate exploration.

(b) Introduction. 1. Object and plan of the report. 2. Acknowledgments.

(c) The Michigan Basin. 1. Major structure. 2. Minor structure. 3. The geological section and formations described.

(d) Geological factors controlling the occurrence of oil and gas. 1. The anticlinal theory. 2. Forms of oil and gas reservoirs. 3. Generalizations concerning the application of the anticlinal theory. 4. Rock pressure and its causes. 5. Surface indications of oil and gas.

(e) The Port Huron oil field. 1. Early history and development. 2. Geological conditions in western Ontario. 3. The Petrolia oil field. 4. Explorations and records of wells in western Ontario. 5. Explorations and records of wells in the Port Huron oil field. 6. The Port Huron anticline. 8. The oil horizons. 9. Early salt wells in Huron and Sanilac counties.

(f) The southeastern district. 1. Rock structures. 2. Relation of surface signs to oil and gas horizons. 3. Explorations and records of wells in Monroe, Lenawee, Hillsdale and Wayne counties. 4. Local structures Wyandotte and Stony Island anticlines. 5. Explorations and records of wells in Washtenaw, Oakland, Macomb and St. Clair counties. 6. Local structures in Macomb and eastern St. Clair counties. 7. Conclusions.

(g) The Saginaw oil field. 1. The Saginaw Valley Development Company. 2. The Saginaw anticline. 3. The explorations. 4. The oil horizons. 5. Favorable area for exploration. 6. Character and composition of the oils.

(h) Central Michigan. 1. Geographic and geologic relations. 2. Explorations and records of wells in Bay, Saginaw, Genesee, Midland, Gratiot, Isabella, Gladwin, Mecosta, Kent, Ionia, Barry, Eaton, Ingham, Jackson and Calhoun counties. 3. Local geology in Livingston, Shiawassee and Clinton counties. 4. Explorations and records of wells.

(i) The southwestern district. 1. Occurrence of oil in the vicinity of Allegan. 2. Character of the formations and local structures. 3. Explorations and records of wells at Allegan. 4. The local structures in Berrien, Cass, St. Joseph and Kalamazoo counties—the Berrien Springs syncline and the anticline near Niles. 5. The oil horizons. 6. Explorations and records of wells.

(j) Western Michigan. 1. Explorations and records of wells in Muskegon, Mason and Manistee counties. 2. The Manistee anticline. 3. Occurrence of gas in the vicinity of Portage Lake, Manistee county, the Onokama gas well.

(k) Northern Lower Michigan. 1. Relation of surface deposits to exploration. 2. Bed rock geology. 3. Little Traverse bay or Khagashewing Point anticline. 4. Explorations and records of wells in Benzie, Emmet, Charlevoix, Wexford, Cheboygan, Crawford, Roscommon, Presque Isle and Alpena counties. 5. Local structures in the north-eastern part of the Southern Peninsula. 6. Relation of rock formations to surface signs in Alcona county. 7. Explorations and records of wells. 8. Conclusions. 9. Explorations and records of wells in Iosco, Ogemaw and Arenac counties.

(l) Northern Peninsula. 1. The Paleozoic area. 2. The Wisconsin section. 3. Explorations and records of wells in eastern Wisconsin and Menominee and Delta counties. 4. Occurrence of oil and asphalt in the Trenton limestone. 5. Explorations and records of wells in Schoolcraft, Mackinac and Chippewa counties and on Manitoulin Island, Ontario.

(m) The regulation of drilling and care of deep borings. 1. Flooding of oil and gas sands by water from improperly cased or abandoned and unplugged wells. 2. Menace of oil and gas wells to coal mining operations and to valuable brines, mineral and potable waters. 3. Necessity for the regulation of the drilling and care of borings. 4. Inadequacy of present laws. 5. Difficulties of framing adequate remedial and preventative measures. 6. Conference of interested parties called by the U. S. Bureau of Mines. 7. The proposed regulations.

(n) Bituminous or oil shales. 1. Oil shale industry in the United States in 1860. 2. History of the oil shale industry in Scotland and other countries. 3. Investigation of the oil shale resources of eastern Canada by the Department of Mines of Canada in 1910. 4. By-products of the oil

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Publication 15, Geological Series 12. 1913.

Brine and Salt Deposits of Michigan, by Chas. W. Cook, 181 pp., 15 Pls., 47 Figs.

- (a) Introduction. 1. Distribution. 2. Physical properties of salt. 3. Previous work.
 (b) Historical account. 1. Governmental development. 2. Private initiative.
 (c) Theories of the origin of salt deposits. 1. Volcanic. 2. Evaporation—the Ochsenius and Walther's. 3. Dome.
 (d) Brine theories. 1. Original sea water. 2. Solution.
 (e) Geology of the brine and rock salt formations and the character and origin of the brines and rock salt. 1. Parma. 2. Marshall. 3. Berea Grit. 4. Dundee. 5. Upper Monroe or Detroit River Series. 6. Salina. 7. Summary.
 (f) Salt manufacture. 1. Wells—well drilling machinery, boring and pumping methods. 2. Preliminary treatment of brines. 3. Methods of evaporation—direct heat and steam.
 (g) Character, production and value of salt in Michigan.
 (h) Geology, production and operating companies by counties. 1. Saginaw. 2. Bay. 3. Huron. 4. Macomb. 5. Iosco. 6. Midland. 7. Gratiot. 8. Manistee. 9. St. Clair. 10. Mason. 11. Wayne. 12. Isabella.
 (i) Appendix A. Bibliography of Michigan salt deposits.
 (j) Appendix B. The salt inspection law..... .60 .10

Publication 16, Geological Series 13. 1913.

Mineral Resources of Michigan for 1913 and prior years.

- (a) The Michigan Copper Industry in 1913 by R. E. Hore. 1. General conditions. 2. Profits and losses. 3. Cost of mining. 4. Wages paid. 5. Exploration. 6. New construction. 7. Earnings and dividends. 8. Summary of mining operations for 1913 by mines. 9. Statistical tables of production and value of copper. 10. Summaries of financial statements of mining companies.
 (b) The Iron Ore Reserves of Michigan by R. C. Allen. 1. A brief description of the iron bearing formations—relation to other formations; thickness, deformation and alteration; the formation of the ore bodies; depth to which iron ore occurs. 2. Importance of the iron mining industry in Michigan. 3. Permanency of the industry—mining at deep levels, development of unexplored lands, opening of abandoned mines, utilization of low grade ores, and recent estimates of Michigan iron ore reserves. 4. Royalty and ownership. 5. Value of iron ore in Michigan in 1913. 6. Statistical tables on production and value of iron ore, on iron ore reserves, mining costs and appraised value of mines, prices of ore, freight rates, iron ore shipments by mines, ranges and counties. 7. List of active iron mines with location, ownership, depth of bottom levels and number of men employed.
 (c) Non-metallic Minerals by R. A. Smith. 1. Limestone—general business conditions, description of the limestone formations, location and character of the principal deposits, statistical tables of production and value. 2. Lime—general business conditions and statistical tables. 3. Sandstone—general character of the sandstones of Michigan, causes of the decline of the sandstone industry, statistical tables. 4. Shale—Uses of shale and location of shale resources. 5. Trap rock—location of the trap rock deposits, growth of the industry, statistical tables. 6. Grindstones and scythestones—location of the grit or grindstone quarries and method of quarrying. 7. The Michigan Slate Industry by O. R. Hamilton—location and description of the black slate deposits of Baraga county, attempted development, former production and value of slate. 8. Sand and gravel—growth of the industry, difficulty of obtaining complete statistical data, the use of sand and gravel for concrete aggregates, statistical tables. 9. Salt—general trade conditions, seats of the industry, extent of the salt beds, statistical tables. 10. Cement—growth of the industry in Michigan, increased price in 1912-1913, future outlook, statistical tables. 11. Gypsum—growth of the industry in Michigan, present developments, extent and distribution of the gypsum resources, statistical tables. 12. Clay—character and uses of the clays of Michigan, statistical tables. 13. Pottery—trade conditions and statistical tables. 14. Brick and tile—general trade conditions, character of the brick and tile products in Michigan, statistical tables. 15. Sand-lime brick—growth and importance of the industry in Michigan, location of the plants, statistical tables. 16.

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Mineral waters—decline and causes of the mineral water industry in Michigan, statistical tables. 17. Natural gas—"shale" and surface gas wells, statistical tables. 18. Petroleum. 19. Graphite—location of the graphite deposits. 20. Quartz. 21. Mineral paints—metallic paint from iron ore. 22. Coal—statistical tables. 23. Summary of the production and value of the mineral products of Michigan for 1913. 24. Directory of mineral producers of Michigan for 1913.	\$0.60	\$0.10
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Publication 17, Geological Series 14. 1912-1914.

Biennial Report of the Director of Michigan Geological and Biological Survey, by R. C. Allen, 104 pp., 1 map.

(a) Organization of the Geological and Biological Survey; 1. Expenditures; 2. Employees.

(b) Powers and duties of the Board of Geological Survey.

(c) Functions of the Geological Survey; 1. Distribution of reports; 2. Correspondence and conferences; 3. Cooperation with the Board of State Tax Commissioners in the appraisal of mines and mineral lands; 4. Reports of the State Geologist to the Board of State Tax Commissioners; 5. Cooperation with the Michigan Securities Commission; 6. Cooperation with the Public Domain Commission.

(d) Progress of the Geological Survey of Michigan; 1. Geological work in the Gwinn Iron Bearing District; 2. On the east end of the Menominee Iron Range; 3. Resurvey of the Gogebic Iron Range between Wakefield and Lake Gogebic; 4. Laboratory studies of Precambrian rocks in the district between Lake Gogebic and Iron River; 5. Monograph on the copper ore deposits of Michigan; 6. Report of the geology of Limestone Mountain; 7. Report on the brine and salt deposits of Michigan; 8. Report on the occurrence of oil and gas in Michigan; 9. Geologic investigation of the limestone resources of Michigan; 10. Studies of the Dundee, Traverse, and Marshall formations; 11. Study of the physiography of Michigan inland lakes; 12. Geologic and physiographic studies of Mackinac Island; 13. Annual report on mineral resources and statistics of mineral production.

(e) Progress of the topographic survey of Michigan; 1. Object of the survey; 2. Expenditures for cooperative topographic survey of Michigan; 3. Plan of cooperation in topographic mapping; 4. Report of topographic surveys July 1, 1912, to July 1, 1914. 5. Table of progress of the topographic survey in the United States.

(f) Progress of the Biological Survey of Michigan; 1. Plan of work; 2. Field work for 1913 and 1914; 3. Publications; 4. Recommendations.

(g) Recommendations to the Legislature relative; 1. To a proposed increase in appropriations for topographic mapping—need for and uses of topographic maps, appropriations for the Topographic Survey; 2. To the investigation of water powers, drainage, etc.; 3. To the need of a soil survey of Michigan—organization of a Soil Survey, recommendations; 4. To the regulation of the drilling and care of deep borings—harmful results of unregulated deep drilling, proposed regulations; 5. To the relation of the Geological and Biological Survey to the conservation of the birds and wild animals of the state; 6. To the proposed work of the Biological Survey—report of the Committee on Policy of the Biological Survey, plan of work, and nature of publications.

(h) Catalog and tables of contents of the publications of the Michigan Geological and Biological Survey, 1838-1914.

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Publication 18, Geological Series 15. 1915.

Part I. Contributions to the Pre-Cambrian Geology of Northern Michigan and Wisconsin, by R. C. Allen and L. P. Barrett. 152 pp., 12 pls., 11 Figs.

Part II. The Geology of Limestone Mountain and Sherman Hill in Houghton county, Michigan, by E. C. Case and W. I. Robinson. 29 pp., 5 Figs.

Part I. Contributions to the Pre-Cambrian Geology of Northern Michigan and Wisconsin.

(a) Introduction and acknowledgments.

(b) A revision of the correlations of the Huronian group of Michigan and the Lake Superior region; 1. Correlation of the Animikie series as Middle Huronian; 2. Correlation of the Huronian group in the Gogebic and Marquette districts; 3. Correlation of the Vulcan (iron bearing) series with the Negaunee (iron bearing) series—Marquette and Crystal Falls districts; 4. Correlation of the Negaunee series with the Vulcan series of the Sturgeon trough, Felch Mountain district, Calumet trough, and Menominee range; 5. Correlation of the Ironwood (Animikie) of the Gogebic range with the Vulcan (Middle Huronian) series of the Crystal Falls-Iron River-Florence-Menominee district on the basis of similar relations to intrusive granite; 6. General remarks on the correlation of the Animikie series with the Middle Huronian.

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(c) A revision of the sequence and structure of the Pre-Keweenaw formations of the eastern Gogebic iron range; 1. Introductory statement—summaries of the geology based on earlier work and of the writers' conclusions; 2. Archean system; 3. Algonkian system: Lower Huronian—Sunday quartzite and Bad River limestone; Middle (Animikie) Huronian—introductory statement, relation to other formations, geology of the Palms and Ironwood formations, Middle Huronian extrusives, basic extrusives, Presque Isle granite; Upper Huronian—The Copps formation; Keweenaw series—Relation to adjacent formations, Keweenaw(?) gabbro; 4. Structure of the Gogebic range east of Wakefield—Keweenaw series, Copps formation, and Middle Huronian series.

(d) Geology of the Marenisco range; 1. Introductory statement; 2. Archean system—northern area, southern area, relations to adjacent rocks; 3. Middle Huronian (Animikie) series—graywacke-quartzite, iron formation, slate formation, igneous rocks.

(e) Geology of the Turtle Range; 1. Introduction; 2. Successions on the Turtle range; 3. Archean; 4. Huronian group—Lower and Middle; 5. Igneous rocks.

(f) Geology of the Manitowish Range; 1. Results of diamond drilling; 2. General summary.

(g) Geology of the Vieux Desert district—conclusions.

(h) Geology of the Conover district; Petrographic description of the Conover slates.

(i) The Paint slate and the Wolf Lake granite, gneiss, and schist: 1. The Paint slate formation; 2. Petrographic descriptions of the Paint slate; 3. Summary statement; 4. Granites, gneisses, and schists of the Wolf Lake area; 5. Relations of the Wolf Lake granite and mica schist to the Paint slate.

(j) Correlation and structure of the Pre-Cambrian formations of the Gwinn iron bearing district; 1. Previous geological work; 2. Recent studies; 3. Location, topography, etc.; 4. Notes on the structure of the Gwinn synclinorium; 5. Archean system; 6. Algonkian system: Middle Huronian—Gwinn series; Upper Huronian—Princeton series; 7. Keweenaw series (?); 8. Paleozoic; 9. Correlation of the Gwinn and Princeton series.

(k) Evidence of the Middle-Upper Huronian unconformity in the quartzite hills of Little Lake Michigan; 1. Structure of Little Lake hills; 2. The Lower (Gwinn) series—arkose and conglomerate; 2. Upper (Princeton) series—conglomerate, quartzite and quartz slate; 3. Notes on the correlation.

(l) Relative to an extension of the Menominee iron range eastward from Waucedah to Escanaba, Michigan; Conclusions.

Part II. Geology of Limestone Mountain and Sherman Hill in Houghton county, Michigan.

(a) Location and topography.

(b) Previous geological work.

(c) Stratigraphy and correlation of beds; 1. Mid-Devonian; 2. Niagara; 3. Middle or Upper Richmond; 4. Upper part of Lower Richmond; 5. Lower Richmond; 6. Galena (Stewartville or Upper Galena); 7. Decorah (Upper Blue); 8. Upper Black (Upper buff); 9. Potsdam (Jacobsville).

(d) Structure.

(e) Geological history—The fault between Big and Little Limestone.. \$0.90 \$0.10

Publication 19, Geological Series 16. 1914.

Mineral Resources of Michigan for 1914 and prior years. 359 pp., 18 Pls., 24 Figs.

Part I. Metallic minerals.

(a) Michigan Copper Deposits, by R. E. Hore, 161 pp., 18 Pls., 23 Figs.; 1. Location of the copper mines; 2. Structural features of Keweenaw Point—general geology, structure of Keweenaw series, faulting; 3. The copper bearing rocks—the Keweenaw rocks, classifications and descriptions; 4. Nature of the copper deposits—mode of occurrence, conglomerate lodes, amygdaloid lodes, sandstone lodes. Epidiote beds, cupriferous felsite, fissure veins, paragenesis of copper and calcite, sulphide veins, arsenides and sulphides of copper, arsenic in the copper, copper oxide, silicate and carbonate minerals, accessory minerals containing fluorine, boron, or tungsten, silver in Michigan copper deposits; 5. Geology and development of the copper deposits or lodes and production of copper.—Adventure No. 4 lode, Algoma, Allouez conglomerate, Ashbed lode, Atlantic, Baltic, Calumet conglomerate, Central mine vein, Forest lode, Hancock lodes (No. 3 and No. 4), Indiana lode, Isle Royale, Kearsarge, Lake,—East lode, Mass mine lodes, Evergreen lode, Butler, Ogima, and Knowlton lodes, Michigan lodes, Minnesota lodes, Nonesuch lode, Osceola, Pewabic, Phoenix mine vein, Superior lode, Superior "West" lode, Winona production of the several lodes in 1912; 6. Origin of the deposits—views of geologists, deposition of copper by solutions of ferrous salts, deposition of copper from chloride solutions, conclusions of R. E. Hore as to the origin of the deposits.

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(b) The Copper Industry in 1914, by Walter E. Hopper, 35 pp. 1. General review: the strike of the copper miners, effects of the strike on production and mining costs, losses, effects of the European war—loss of foreign markets, closing of copper mines, disorganization of the domestic copper markets, recovery of the copper market at the close of 1914, disasters in the copper country—fires and boiler explosions; 2. Construction work—restriction by strike of 1914; 3. Mine casualties; 4. Sanitary conditions; 5. The Copper Handbook—removal of publication office from Houghton to New York City; 6. The Douglass Houghton memorial at Eagle River; 7. Details of operations of the mining companies in 1914; 8. Statistical tables by R. E. Hore and W. E. Hopper.

(c) Iron Ore—Statistical tables, by R. C. Allen and O. R. Hamilton, 22 pp.

Part II. Non-Metallic Minerals, by R. A. Smith.

(a) Coal in Michigan, 23 pp.: 1. Michigan Coal Basin—location and extent, surface features, accessibility, geology, character and thickness of the coal measures, occurrence of the coal, quality, analyses; 2. Development, history of coal mining, mining conditions, methods of mining; 3. Markets; 4. Production and statistical tables.

(b) Limestone; 1. Growth of industry; 2. Location of quarries; 3. Statistical tables.

(c) Lime; 1. Slow growth of industry; 2. Unfavorable location of kilns; 3. Quality of lime; 4. Production, 5. Statistical table.

(d) Sandstone; 1. Decline of industry; 2. Cause; 3. Statistical table.

(e) Trap Rock; 1. Unfavorable location of deposits and quarries; 2. Statistical table.

(f) Grindstones and Scythestones; 1. Location and character of the grit stones; 2. Location of quarries.

(g) Sand and Gravel; 1. Decrease in production in 1914; 2. Extent of sand and gravel resources; 3. Statistical table.

(h) Salt; 1. Production and rank of state in 1914; 2. Former center of industry—Saginaw Valley; 3. The salt producing districts; 4. Rapid development of industry in Wayne county; 5. Mining of rock salt; 6. Manufacture of bromine, bromides, and calcium chloride; 7. Occurrence of the rock salt deposits; 8. Depth; 9. Probable extent; 10. Statistical tables.

(i) Cement; 1. Growth of industry; 2. Raw material; 3. Production; 4. Distribution; 5. Market prices; 6. Statistical tables.

(j) Gypsum Deposits in Michigan, 8 pp.: 1. Occurrence and development; 2. Character, extent, and thickness of the beds; 3. The gypsum bearing formation; 4. The gypsum bearing districts—the Grand Rapids-Grandville, the Alabaster-Turner district (Iosco and Arenac counties), and the St. Ignace; 5. History of gypsum industry; 6. Production and disposition of product; 7. Statistical tables.

(k) Clay; 1. Character and occurrence—brick and tile, pottery, and slip clays; 2. Developments; 3. Uses—brick and tile, pottery, glazing.

(l) Pottery; 1. Growth of industry; 2. Character of products; 3. Sources of raw material; 4. Statistical tables.

(m) Brick and Tile Products; 1. Raw materials; 2. Production; 3. Rank of state; 4. Development of common brick industry near Detroit; 5. Drain tile and sewer-pipe; 6. Statistical tables.

(n) Sand-lime Brick; 1. Factors affecting the growth of the industry; 2. Production; 3. Rank of state; 4. Statistical table.

(o) Mineral and Spring Waters; 1. Fluctuating production and causes; 2. General decline of industry; 3. Table of production.

(p) Natural Gas; 1. Sources—surface deposits, bed rocks; 2. Surface gas wells—Macomb, Oakland, Washtenaw, and Manistee counties; 3. Rock wells—Port Huron oil field; 4. The gas and oil bearing strata; 5. Statistical table.

(q) Petroleum; 9 pp.: 1. The Port Huron field—discovery of the Petrolia Oil Springs fields in Ontario, the C. A. Bailey and G. B. Stock explorations, the development companies, records of the recent test wells, the Port Huron anticline, the surface deposits and surface gas, the rock formations, the oil bearing formation; 2. Explorations at Cadillac, Wexford county; 3. H. R. Ford test well at Dearborn, Wayne county,—plan to drill to the depth of 5,000 feet or to the pre-Cambrian granite.

(r) Quartz; 1. Production and uses; 2. Location of mines and mills.

(s) Mineral Paints; 1. Raw materials; 2. Producers.

(t) Relative to Potash deposits in Michigan: 1. Studies on the Devonian and Silurian formations in Michigan, by A. W. Grabau; 2. Possibilities for the occurrence of potash salts in the lowest rock salt beds in southeastern Michigan; 3. Uses of potassium salts; 4. Importance of a reliable source; 5. Investigations by the U. S. Geological Survey and the U. S. Bureau of Soils; 6. Occurrence, extent, and depth of the rock salt beds in Michigan.

(u) Summary table of the production and value of mineral products in Michigan, 1910-1914.

(v) Appendix—Directory of the producers of non-Metallic minerals in Michigan for 1914.

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Publication 20, Biological Series 4, 1915.

Miscellaneous Papers on the Zoology of Michigan. 179 pp.
28 Pls. 3 Figs.

- (a) Observations on the fishes of Houghton county by Thomas L. Hankinson. 12 pp. 8 Plates. 1 Fig. 1. Local distribution of fish—Stonington, South Twin, North Twin, Kratt and Bear Lakes. 2. Habitat and distribution in South Twin Lake. 3. Conclusion. 4. List of species.
- (b) An ecological study of the fish fauna of the Douglas Lake region (Michigan) with special reference to the mortality of the species by Roy J. Colbert. 13 pp. 1 Fig.
- (c) Dragon Flies of the Douglas Lake region (Michigan) by Arthur T. Evans. 20 pp. 2 Plates.
- (d) Reptiles and amphibians of Monroe County by Crystal Thompson. 3 pp. List of species.
- (e) Results of the Mereson expedition to the Charity Islands, Lake Huron: Coleoptera, by A. W. Andrews. 42 pp. 1. Habitat distribution of the coleoptera. 2. List of species.
- (f) Results Shiras expeditions to Whitefish Point, Michigan: Fishes, by T. L. Hankinson, 161 pp. 17 Plates. 1 Fig. 1. General description of region. 2. Fish habitats. 3. List of species. 4. Hypothetical list of species. 5. Summary and conclusion. 6. Bibliography.

Publication 21, Geological Series 17.

Mineral Resources of Michigan with statistical tables of production and value of mineral products for 1915 and prior years. 402 pp. 8 Pls. 15 Figs.

Part I. Metallic Minerals.

- (a) Michigan Copper Industry in 1915 by W. E. Hopper, 55 pp.: 1. General review. 2. Exploration and development work. 3. Construction work. 4. Dividends. 5. Mine casualties. 6. Details of operations of the mining companies in 1915. 7. Statistical tables.
- (b) Iron Industry—Statistical Tables, by R. C. Allen and O. R. Hamilton. 1. Iron ore shipments by districts. 2. Summary of iron ore shipments by ranges and counties. 3. List of active iron mines. 4. Iron ore reserves of Michigan. 5. Appraised value of Michigan iron mines. 6. Value of Michigan iron ore shipments in 1915. 7. Costs, profits, losses, and assessments, iron mines of Michigan.

Part II. Non-Metallic minerals by R. A. Smith.

- (a) Limestones of Michigan. 209 pp. 8 Pls. 15 Figs. 1. Origin of limestone. 2. Classification and varieties of limestones. 3. Uses of limestone and lime. 4. Geology of limestone formations—geologic distribution and character of pre-Cambrian and Paleozoic limestones and marl or bog lime deposits. 5. Distribution, character, and development of limestone deposits by counties.
- (b) Miscellaneous non-metallic minerals. 1. Coal—growth in production, cost of mining, markets, methods of mining; statistical tables. 2. Limestone industry—growth of industry, character of the deposits, and statistical tables. 3. Lime industry—growth, statistical table. 4. Sandstone—decline of industry, statistical table. 5. Grindstones and scythestones—occurrence and development. 6. Sand and gravel—occurrence and development, statistical tables. 7. Salt—growth of industry, occurrence and extent of salt deposits, statistical tables. 8. Cement—growth of industry, statistical tables. 9. Gypsum—growth of industry, occurrence of beds, statistical tables. 10. Clay—Classes, quality, occurrence and uses. 11. Pottery—growth of industry, classes of products, statistical table. 12. Brick and tile products—raw materials, nature of product, statistical tables. 13. Sand lime brick—growth of industry, statistical table. 14. Mineral and spring waters—decline of industry, statistical table. 15. Natural gas—occurrence, statistical table. 16. Petroleum—occurrence and production. 17. Trap rock—occurrence and development, statistical table. 18. Shale—occurrence and development. 19. Graphite—occurrence of graphitic slates, development. 20. Quartz. 21. Mineral paints. 22. Summary table of production and value of mineral products in Michigan, 1911-1915.
- (c) Appendix. Directory of producers of non-metallic minerals in Michigan in 1915.

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Publication 22, Geological Series 18, 1914-1916.

Biennial Report of the Director of the Michigan Geological and Biological Survey by R. C. Allen, pp. 118, Pls. 15.

(a) Organization of the Geological and Biological Survey. 1. Tables of expenditures. 2. Employees of the Board of Geological Survey, July 1, 1914 to July 1, 1916.

(b) Progress of the Geological Survey.

(c) Co-operative work. 1. With the Board of State Tax Commission. 2. The Public Domain Commission. 3. The Michigan Securities Commission. 4. The Mackinac Island State Park Commission.

(d) Geological work. 1. Geological map of Michigan. 2. Report of Michigan limestones. 3. Studies of the pre-Cambrian rocks of the Northern Peninsula. 4. Studies of the Devonian formations. 5. Of the Mississippian formations. 6. Of the Paleozoic formations of the Northern Peninsula. 7. Of the physiography of Michigan inland lakes. 8. Mineral statistics.

(e) Progress of the Topographic Survey: 1. Expenditures of the Co-operative Topographic Survey of Michigan. 2. Importance of the Topographic Survey to the development of the state.

(f) Progress of the Biological Survey: 1. Report of the Chief Naturalist.

(g) Retracement and permanent monumenting of the Michigan-Ohio boundary: 1. Part I. Report of commissioners. 2. Part II. Report of engineer. 3. Part III. Basis of Ohio-Michigan boundary dispute. 4. Bibliography of the Ohio-Michigan boundary dispute. 5. Appendix I. Distribution of reports of the Geological Survey. 6. Appendix II. Catalog and table of contents of the publications of the Michigan Geological and Biological Survey.

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